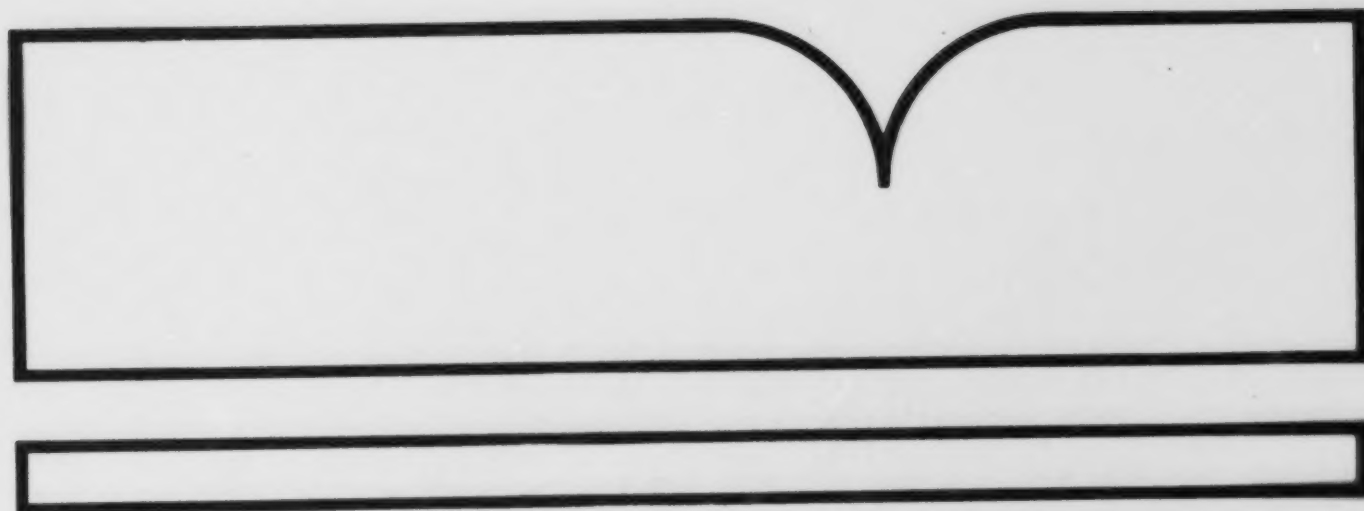


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Conveyance Systems: 1973-1979

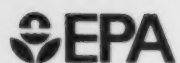
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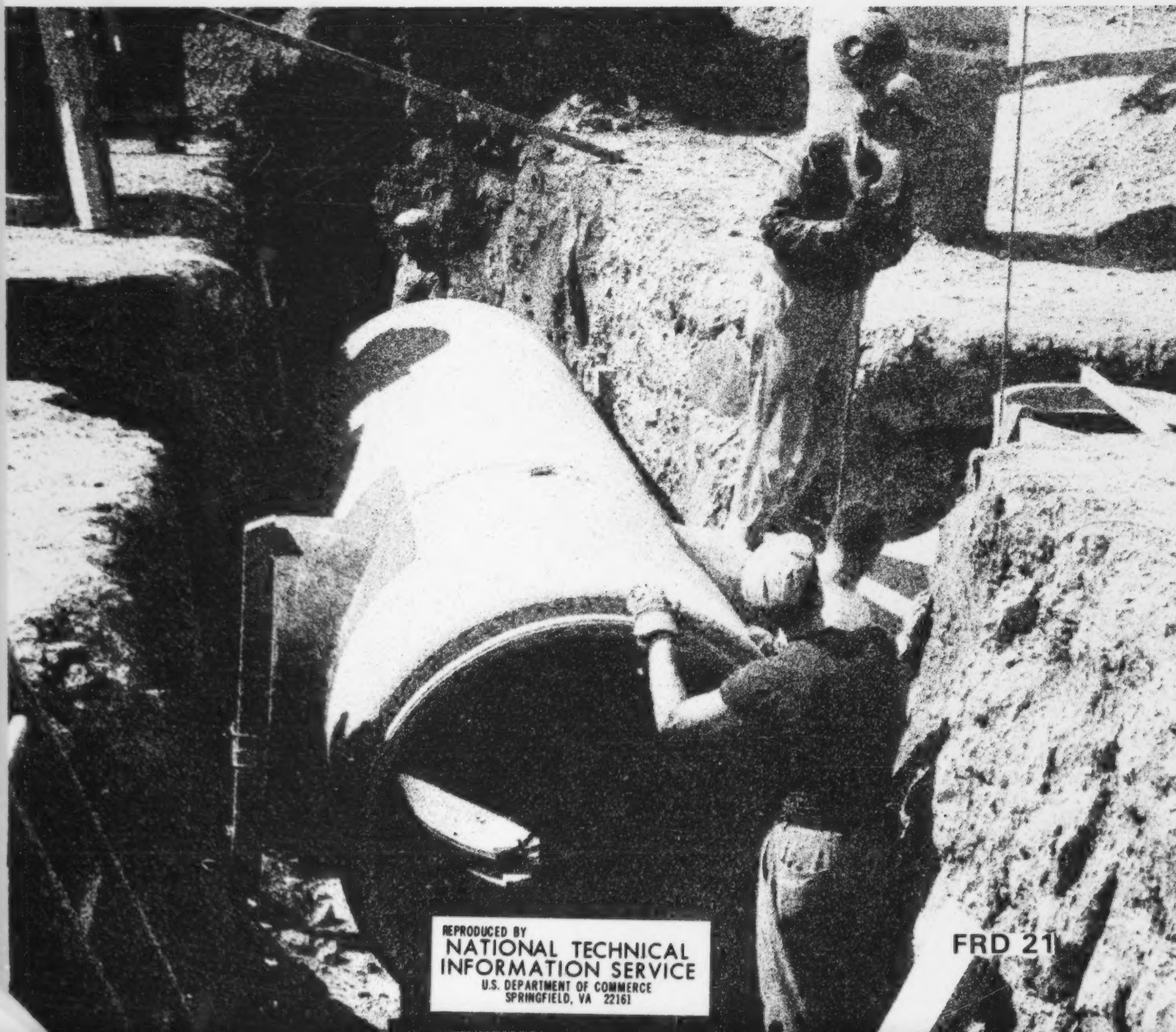


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The three technical reports listed below were prepared in conjunction with the 1980 Update of Needs for Municipal Wastewater Treatment Facilities, a biennial report to the U.S. Congress. This series of reports provide construction cost relationships and also related operations and maintenance (O&M) cost relationships for existing facilities. The data base for all three studies is representative of the ten regions.

<u>Document Number</u>	<u>Title</u>
430/9-80-003 FRD-11	Construction Costs for Municipal Wastewater Treatment Plants: 1973-1978
430/9-81-003 FRD-21	Construction Costs for Municipal Wastewater Conveyance Systems: 1973-1979
430/9-81-004 FRD-22	Analysis of Operations and Maintenance Costs for Municipal Wastewater Treatment Systems

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CONSTRUCTION COSTS FOR MUNICIPAL
WASTEWATER CONVEYANCE SYSTEMS: 1973-1979

Prepared For

U.S. ENVIRONMENTAL PROTECTION AGENCY
FACILITY REQUIREMENTS DIVISION
WASHINGTON, D.C. 20460

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1.0 INTRODUCTION

This report presents the results of a study of the costs for construction of municipally owned wastewater collection systems. Collection systems are defined as gravity collector sewers, interceptors, pumping stations, and associated force mains necessary to collect and transport wastewater to a treatment facility. Thus, all data is from gravity sewer systems, including all those from small communities. The cost data utilized in this report are derived from the winning bid documents of projects funded by the Federal Water Pollution Control Act (P.L. 92-500) and its amended version (P.L. 95-217). All data were collected from the Construction Grant files in the ten EPA Regional offices.

This report is an update and replacement of a previous report in this series, entitled "Construction Costs for Municipal Wastewater Conveyance Systems: 1973-1977," EPA 430/9-77-015, MCD-38, May, 1978. The data base utilized in that report included 455 wastewater collection system projects funded under P.L. 92-500.

Three hundred twenty-two new projects have been added to the MCD-38 data base mentioned above, resulting in 777 collection system projects reported herein. These projects had a total construction cost value of approximately \$2.02 billion, adjusted to first quarter 1979 dollars.

All ten EPA Regions are represented in the data base. In fact, all of the 48 contiguous States are represented with the exception of Kentucky. The EPA Regions are shown on Figure 1.1. Table 1.1 presents a Regional/demographic distribution of the communities in which projects used in the data base fall. Appendix G lists each project by grant number, name, city, State, and county.

Over 30 percent of the projects in the data base received grants to assist communities with a population of less than 2,500 people. Sixty-eight projects, or 8.75 percent of the data base, are classified as "indeterminate" for population purposes. The population of these communities or authorities was

FIGURE 1.1
EPA REGIONS

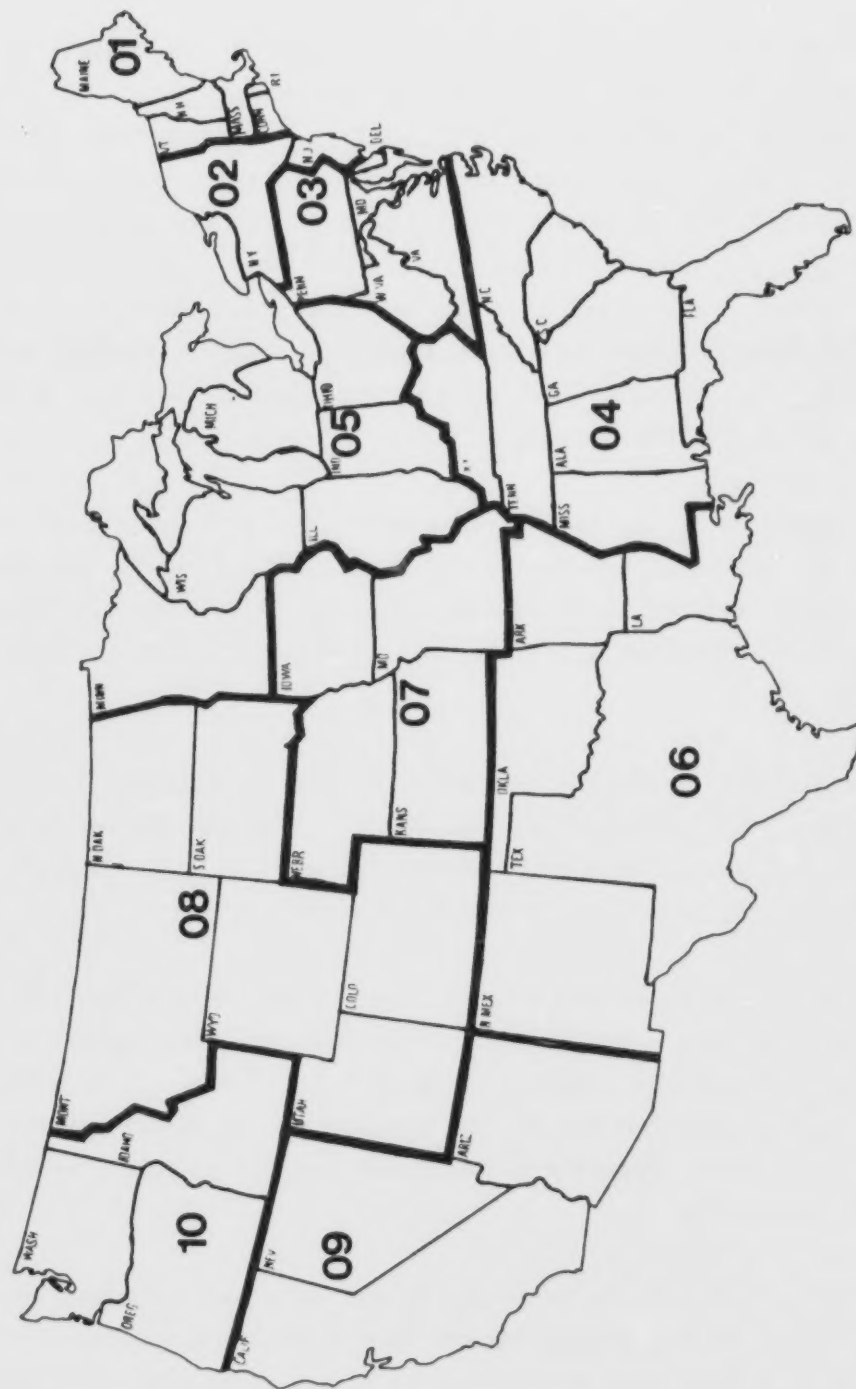


TABLE 1.1
REGIONAL AND COMMUNITY SIZE DISTRIBUTION
ALL PROJECTS IN DATA BASE

Community Size	Region 01	Region 02	Region 03	Region 04	Region 05	Region 06	Region 07	Region 08	Region 09	Region 10	National
0 - 2,500	20	25	40	10	44	19	22	19	22	19	240
2,501 - 5,000	5	11	6	7	13	4	9	4	7	8	74
5,001 - 10,000	8	10	20	6	22	8	11	3	3	2	93
10,001 - 25,000	9	5	15	5	34	13	12	7	6	7	113
25,001 - 50,000	7	6	12	5	14	6	2	5	3	8	68
50,001 - 100,000	5	4	9	3	4	0	1	2	3	1	32
100,001 - 500,000	4	1	3	9	13	6	4	0	17	1	58
500,001 - 1,000,000	0	0	2	0	7	0	1	4	1	5	20
> 1,000,000	0	0	0	0	10	0	0	0	1	0	11
Indeterminate	4	9	14	2	14	5	5	9	2	4	68
TOTALS	62	71	121	47	175	61	67	53	65	55	777

unable to be discerned through available census figures. Most, if not all, of these projects are thought to be for small communities, certainly most with populations less than 5,000 people.

The true magnitude of the data base is only partially expressed by the 777 bid documents examined. Table 1.2 illustrates that 4,737 miles of gravity sewers, 702 miles of force mains, and 1,165 pump stations are contained in the bid documents. These represent considerable construction expenditures. Perhaps of greater significance is the number of individual bid items utilized in the analyses presented in this report. Each bid document contains a single lump sum construction cost. This total construction cost is made up of many separate bid items, often dozens. For a sewerage project it is unusual that all the pipe to be laid will be of the same diameter. Each size is itemized separately in the bid. Likewise, many appurtenances (manholes, stream crossings, special bedding, etc.) are bid separately. Over 11,500 individual bid items for gravity sewers alone were available for analysis. Over 15,000 individual bid items make up the sample used to derive the results found in this report. This information is certainly the most comprehensive empirical analysis of sewer construction costs available for the United States to date.

All costs presented in the main body of this report have been normalized to Kansas City, Missouri and updated to the first quarter of 1979. Appendix A describes the procedures used for updating costs.

Simplified collection system cost estimating techniques were developed using a substantial portion of the data base included in this report. These techniques were used for cost estimating in the 1980 Needs Survey. They are included in this report as Appendix B.

Only data for the contiguous 48 States have been presented. Alaska, Hawaii, Puerto Rico, and the Pacific territories are atypical of the mainland. Inclusion of data from these locations would severely bias national and regional averages and trends.

TABLE 1.2

LENGTHS OF GRAVITY SEWER AND FORCE MAIN
AND NUMBER OF PUMP STATIONS IN DATA BASE

State	Length of Gravity Sewers (Miles)	Length of Force Main (Miles)	No. of Pump Stations
Alabama	54.36	19.01	9
Arizona	52.53	4.82	7
Arkansas	100.57	13.09	18
California	300.93	41.24	35
Colorado	59.79	1.13	0
Connecticut	61.92	5.10	24
Delaware	78.25	34.06	18
Florida	1.45	8.89	4
Georgia	75.81	13.37	12
Idaho	37.95	7.50	7
Illinois	93.55	12.62	18
Indiana	282.04	39.12	69
Iowa	21.78	4.50	8
Kansas	23.90	7.43	17
Louisiana	287.70	44.66	98
Maine	13.60	4.42	18
Maryland	104.74	11.42	36
Massachusetts	49.83	7.52	29
Michigan	396.54	28.95	85
Minnesota	37.84	17.62	43
Mississippi	30.41	4.41	5
Missouri	57.24	27.00	30
Montana	0.44	0.00	0
Nebraska	20.94	4.89	6
Nevada	56.87	7.55	12
New Hampshire	65.60	4.58	12
New Jersey	407.69	62.12	83
New Mexico	58.46	2.19	5
New York	115.52	13.28	48
North Carolina	51.09	14.04	5
North Dakota	17.14	8.25	7
Ohio	275.15	31.42	53
Oklahoma	73.65	14.33	16
Oregon	36.56	4.22	13
Pennsylvania	565.11	41.09	80
Rhode Island	8.20	1.20	9
South Carolina	82.91	15.81	15
South Dakota	43.47	7.41	8
Tennessee	18.95	13.85	9
Texas	155.76	24.13	37
Utah	118.59	1.39	3
Vermont	18.95	4.57	22
Virginia	125.04	28.17	64
Washington	76.89	18.71	30
West Virginia	87.68	11.32	31
Wisconsin	22.91	8.92	5
Wyoming	10.75	0.34	2
TOTALS	4737.05	701.66	1165

Two important purposes are served by the results contained herein. First, an historical record of a significant number of wastewater collection system cost data is made available to administrators and managers of the Construction Grants Program at both the Federal and State levels. The information should be valuable in managing this Program.

The second purpose for which this document is intended will be its use in preliminary estimation of construction costs for collection systems by engineers, planners, sewerage authorities, and interested laymen. The reader is cautioned that the costs stated herein are not a substitute for normal engineering estimating procedures, but are only averages for the specific data collected. Furthermore, unless the specific item being addressed has a substantial number of data points, site specific characteristics can cause highly under or over-stated values for that item.

2.0 HIGHLIGHTS OF FINDINGS

Results obtained from the analysis of the large data base gathered by this effort fall within the normal range to be expected. The types of projects and their geographic diversity tend to cause some unexpected variation. Some trends are also surprising, but most are explained when the number of data points is considered. The highlights presented in this section are for various items which have sufficient data to be considered accurate, but which may seem to be anomalies. Some items are verification of suspected but undocumented trends. The items discussed are by no means a complete list. It is anticipated each reader will find similar cases upon detailed study of the data presented. These highlights are not presented in any order of apparent importance or significance.

- Reinforced concrete was the most commonly used pipe, followed closely by vitrified clay. At diameters less than 16 inches, the latter was more prevalent.
- ABS (acrylonitrile-butadiene-styrene) was the type least commonly used.
- Relatively small differences in costs were noted for pipes buried less than 8 feet deep compared with those buried between 8-15 feet deep.
- Pipes buried greater than 15 feet deep were significantly more expensive than those in the 8-15 feet deep range.
- The cost of pipe delivered to the construction site was more expensive at construction sites located within a Standard Metropolitan Statistical Area (SMSA) for diameters of 21 inches and less than for non-SMSA (rural) areas. This trend was reversed for larger diameters.
- The cost of labor for gravity sewer construction within SMSA's was significantly more expensive than in non-SMSA's, as would be expected.
- Average Step 3 nonconstruction costs (engineering, administrative, legal, etc.) are approximately ten percent higher in non-SMSA areas than in SMSA's. This is probably due to the fact that non-SMSA projects are of smaller magnitude and, thus, these fees and expenses are a greater percentage of the total construction costs.
- Step 1 costs are nearly twice as high in SMSA areas than in non-SMSA areas. This is attributed to the probable greater number of alternatives which must be considered in an urban area for Step 1 planning.

- Step 2 costs are higher in non-SMSA areas as a percentage of the construction costs than in SMSA's. This is probably due to the smaller size projects in the more rural areas, and the normal experience of engineering fees being a higher percentage for the smaller projects.
- The unit construction costs for manholes were found to be less expensive for those 8-15 feet deep than for those less than 8 feet deep within SMSA's, and nationally.
- Manholes 72 inches in diameter were more expensive in non-SMSA's than in SMSA's, probably because a unit of that size is a special situation in the more rural areas.
- Bare-in-place construction costs for force mains smaller than 21 inches in diameter are significantly less expensive than equivalent size gravity sewers. This is explained by the fact that less attention to grade is required for the former, making construction faster with the use of less skilled labor.
- Relatively few projects for only sanitary sewer construction were available for analysis. Most sewer projects were included as part of collection and treatment projects, at least for Step 1 grants.
- The bid items for cast iron pipe averaged less than 500 feet each, based upon dividing total length in the data base by the number of individual bid items. This result indicates that many of these items were for special situations such as road or stream crossings or short reaches of shallow burial. For instance, of 85 bid items for 8 inch cast iron pipe, the average length per bid item was 390 feet. For the same diameter reinforced concrete pipe and vitrified clay pipe, the average lengths were 1,906 feet and 4,457 feet, respectively.
- Type of pipe was not specified for approximately 25 percent of the bid items. Undoubtedly these were cases where the contractor had a choice of materials and in the bid proposal did not specify the type to be used.
- The depth of burial of sewer pipe was, on the average, greater in cities than in non-SMSA areas.

3.0 DEFINITIONS AND ANALYSIS PROCEDURES

This section of the report defines the terms used throughout. An overview of the data analysis techniques is presented. Data collection methodology and cost updating techniques are also described. More specific discussions relating to individual cost items are contained in Section 4.0, Results of the Data Analysis.

DEFINITION OF TERMS

All projects used in this report were partially funded by the EPA Construction Grants Program under P.L. 92-500 and P.L. 95-217. The rules and regulations pertaining to these laws are quite specific as they relate to procedures for design and construction of the facilities in question. They are applied uniformly across the nation, thus adding further credibility to the data base.

The rules and regulations require that all projects go through specific steps prior to proceeding. These steps are all grant eligible, and are all part of the cost of the planning, engineering, and constructing the facility in question. These steps are referred to throughout the report. Their definitions are as follows:

Step 1 - Facilities Planning. This is basically the preliminary engineering (feasibility analysis) which demonstrates the need for the project and a cost effective analysis of alternative solutions.

Step 2 - Construction Drawings and Specifications. This step is the detailed design of the selected alternative, including all documents necessary to allow competitive bidding on the project.

Step 3 - Actual Construction of the Facility. The monies associated with this step are those necessary to construct the facility. These monies include certain nonconstruction items as described below.

The total costs associated with the above three steps of the Grants procedure were collected and reported on herein. However, the bid documents from which the construction costs were obtained do not include Step 1, Step 2, or Step 3 nonconstruction cost items. These data were obtained from other EPA grant files when available, which was most of the time. Therefore, the total cost of a project includes these items. They have been accounted for in the various tables and analyses presented in this volume and explained in the following paragraphs.

The definitions of the various costs associated with the construction of sewerage projects are presented below. The reader should be completely familiar with these terms prior to utilizing the cost data for estimation purposes.

Total Project Cost. A "project" is defined as the construction associated with a single contract. A project for this study consists of the construction of gravity sewers, force mains, and pump stations. It may include only one of these items, all three, or any combination. The Total Project Cost is the total monies spent to put the facility into operation. This is the sum of all planning costs (Step 1 and Step 2), Step 3 construction costs, and Step 3 nonconstruction costs. Each of these components is more fully described below.

Total Construction Cost. The Total Construction Cost, as defined in this report, is the total of all construction bid items plus the nonconstruction costs directly associated with the construction phase of the project.

Construction Costs. Construction costs are the sum of all individual items submitted in the successful contractor's winning bid. This report has separated these bid items into broad categories of gravity sewers, force mains, and pump stations. These are further defined below.

Gravity Sewers. The cost to construct gravity sewers includes the pipe itself, its placement, and various non-pipe construction costs. These are:

Bare-In-Place Costs. The bare-in-place pipe cost for gravity sewers is the sum of the costs for the labor and materials necessary to install a gravity sewer. These costs include only the costs of the pipe delivered to the site plus all trenching and backfilling. National average costs are summarized for these items.

Non-Pipe Construction Costs. In any project there are a number of non-pipe, appurtenance, and special costs associated with the construction. These construction items are separately itemized in the bid documents. The majority are listed below:

- Appurtenances (tees, wyes, valves, gates, etc.)
- Bedding/Backfill (special)
- Drop Manholes
- Manholes
- Miscellaneous
- Mobilization
- Pavement Replacement
- Rock Excavation
- Stream Crossings
- Thoroughfare Crossings
- Utility Reconnection or Relocation

Force Mains. As in the case of gravity sewers, the cost to construct force mains is the pipe itself, its placement, and various non-pipe construction costs. These are:

Bare-In-Place Costs. The bare-in-place costs for force mains are the sum of the costs for the labor and materials necessary to install a force main. These costs include only the costs of the pipe delivered to the site plus all trenching and backfilling.

Non-Pipe Construction Costs. Force mains, like gravity sewers, require appurtenances and special construction in addition to the actual construction of the main. These are similar to those itemized above for gravity sewers. However, in most projects they make up a lower percentage of the total work.

Pump Stations. In most cases pump stations are bid as a single item. Little or no other construction costs (i.e., non-pump station construction costs) are associated with their construction.

Step 3 Nonconstruction Costs. Step 3 nonconstruction costs are defined as those monies spent during the construction of a project which are not directly paid to the contractor but which must be borne by the owner. They are considered to be part of the Total Construction Cost. The most common nonconstruction costs found in the Step 3 phase of a project are:

- Administrative/Legal Fees
- Preliminary (preconstruction planning)
- Land, Structures, and Right-of-Way
- Architect/Engineer Basic Fees
- Project Inspection
- Land Development
- Relocation Expenses
- Relocation Payments
- Demolition and Removal
- Bond Interest
- Contingencies
- Indirect Costs
- Miscellaneous
- Equipment

(The reader is reminded that Step 1 and Step 2 costs must be added to the Total Construction Cost to estimate the Total Project Cost.)

The results presented in Section 4.0 and in the Appendices detail most of the construction and nonconstruction costs discussed above.

COST UPDATING

All costs initially were updated to first quarter 1979 dollars using the updating procedure described in Appendix A. Step 1 and 2 planning and design costs were updated from their respective grant award date, while Step 3 costs were updated from the project bid date.

The updating procedure described in Appendix A uses the EPA Complete Urban Sewer System Index (CUSS) for 25 cities in the contiguous 48 States. The areas each of these cities have a predominant influence over were also

developed. The cost information for each project was updated using the appropriate index for the city having influence in the area. Although the CUSS Index applies to urban areas, and therefore by inference to SMSA's, it was used for all projects whether urban or rural. Other available indexes were investigated for these normalizing calculations but none resulted in as accurate or consistent results as did the CUSS Index.

All data were normalized to a single location - Kansas City, Missouri. The index for the city in question and that for Kansas City for first quarter 1979 were used to adjust all cost data to Kansas City costs. This procedure was utilized to allow data analysis in a mathematical and logical manner for the complete data base, not just by region or city of influence. Examples of adjusting data to a specific location are provided in Section 4.0 and Appendix C.

DATA ANALYSIS

The more than 15,000 bid items available from the 777 projects in the data base lend themselves to a vast array of analyses. A large number of analyses were performed. Those which had sufficient data elements to be considered statistically reasonable have been included in this publication.

Both nonconstruction and construction costs were developed for gravity sewers, force mains, pump stations, and common appurtenances. Bare-in-place pipe costs for various depths and diameters of pipe were calculated and are included in this report.

Non-pipe costs, as well as Step 3 nonconstruction costs, were added to the unit costs for bare-in-place pipe using a ratio of the volume of each bid item for pipe in each project to the total volume of pipe in each project. All non-pipe costs not specifically related to force mains or pump stations in the bid tabulations were assumed to relate to the gravity sewer portion and were apportioned accordingly. Volume of pipe was used in these calculations because it is influenced less by special construction items and proved to yield statistically better results. Volume of pipe was calculated by the

pipe's cross sectional area in square feet (using the nominal pipe diameter) times the length, in feet of pipe, for that bid item.

Linear regression relationships of design flow and total dynamic head (TDH) versus costs were determined for pump stations. These costs included all costs for the basic pump station in addition to any other bid items specifically related to the pump station. When more than one pump station was present in a single project, all related costs were apportioned among each of the pump stations in a project on the basis of a ratio of the cost for each to the total cost for all pump stations. A computerized statistics package (The Biomedical Computer Program developed by the University of California, Los Angeles) was utilized to determine the significance of these relationships and to plot the resulting linear regression curves.

DATA COLLECTION

Construction cost data from wastewater collection system projects were collected from the EPA Construction Grant files in all ten Regional EPA offices. All data were collected from active or recently completed Step 3 projects. Costs were derived from the winning contract bid tabulations plus the costs associated with all change orders issued up to the time of data collection. All information was collected on specially designed forms using a coding system. Contractor personnel performed all data collection in the Regional offices and had access to the complete project files, including most of the backup engineering information.

The data base includes projects providing new collection systems, as well as projects to enlarge or extend existing collection systems. Many projects also include the construction or modification of wastewater treatment plants. The wastewater treatment plant portion of such projects, however, was segregated into a separate data base which was used to compile a companion report to this document, entitled "Construction Costs for Municipal Wastewater Treatment Facilities: 1973-1978," EPA 430/9-80-003, FRD-11, April 1980.

As previously mentioned in Section 1.0, the data base now includes a total of 777 sanitary sewer projects which started construction between 1973 and 1978.

A total of 348 of these projects have a contract award date of January 1977 or later. All of the projects resulted from grants awarded in accordance with P.L. 92-500 and its successor, P.L. 95-217.

Following a quality assurance check at the contractor's home office, the data were entered into an ADP file. The format of the data base used in the original MCD-38 report was adjusted to conform with the newly acquired data, after which the two files were merged.

4.0 RESULTS OF THE DATA ANALYSIS

The results of the analyses of 777 municipal wastewater collection system projects funded by the EPA Construction Grants Program are presented in this section. These data constitute a significant portion of the total projects funded by the Program.

The data base includes information concerning the type, size, and depths of gravity sewer pipe and force main and the number and capacity of pumping stations. All costs associated with the construction of these facilities are a part of the data base. Most commonly used types of pipe and appurtenances are present in the data base and have been analyzed and presented in the following pages.

The construction cost data were identified as to whether the project was located in a metropolitan or a rural area. The basis for this designation is the Bureau of Census defined Standard Metropolitan Statistical Area (SMSA). Most populated urbanized areas in the country have been made an SMSA. Much of the cost data was analyzed to judge trends between urban and rural areas. This factor will have increasing significance as more facilities are planned for the smaller communities throughout the country. SMSA's have the county as the smallest areal delineation. Some large counties are very densely populated in one section, yet are truly rural in another. The data base does not differentiate between these extremes, all facilities being considered in the SMSA.

The national averages shown for the various pipe diameters are without regard to type of pipe material, depth of burial, or whether in an SMSA.

COSTS FOR GRAVITY SEWERS

Cost data for gravity sewers were the most voluminous and readily available. Nearly 12,000 individual bid items make up the sample analyzed. Results are presented detailing total construction costs, bare-in-place pipe costs, labor and material component costs, and Step 3 non-pipe construction costs. Each series of analyses is presented with discussions below.

Total Construction Costs

Table 4.1 summarizes the total construction costs for gravity sewers. Step 1 and Step 2 costs are not included, as explained in Section 3.0. Average Step 3 nonconstruction costs were added to bare-in-place costs (see Table 4.3) to arrive at these cost figures.

The data presented in Table 4.1 have been segregated into three different groupings: pipe type (the material the pipe is made of), depth of burial, and by SMSA classification. Each bid item did not have all data elements available. If type of pipe was not specified, the cost data were accumulated under the heading "other/unknown."

Figure 4.1 presents this same data in a graphical format to permit the reader to judge basic trends. Only national data are shown.

The unit cost presented for each individual item is the average cost per foot of pipe for that item. The cost per foot of pipe for each bid item was calculated, and then averaged with all the other items of the same nature.

This same data base was used to develop Table 4.2, which presents the cost by pipe type and depth of burial for each pipe diameter. This table is a summary of a more detailed printout which is located in Appendix F. This printout itemizes the unit costs, non-pipe costs, Step 3 nonconstruction costs, and sample footage for each item. There was sufficient documentation for 8,274 bid items to be included in this subset of data.

It should be stressed that the data presented for total construction costs are based upon average pipe costs to which are added average costs for appurtenances and nonconstruction items. These costs represent accurate averages for the national base. However, if, for a particular project, the reader has sufficient knowledge to be able to estimate appurtenance costs, it is recommended the bare-in-place costs plus individual appurtenance costs be used for estimation purposes.

TABLE 4.1

GRAVITY SEWER TOTAL CONSTRUCTION COSTS* (\$/FOOT) PIPE TYPE, BURIAL DEPTH, AND SMSA CLASSIFICATION BY DIAMETER

BY PIPE TYPE:

Diameter	PVC	Asbestos Cement	Vitrified Clay	Cast Iron	Reinforced Concrete	Ductile Iron	ABS	Other/ Unknown
04	15.36 (18)	10.01 (6)	12.37 (16)	10.15 (5)	11.86 (4)	18.11 (4)	17.26 (2)	15.36 (61)
06	13.96 (43)	18.79 (13)	17.37 (119)	24.38 (15)	13.54 (4)	25.32 (22)	24.46 (2)	21.12 (160)
08	38.29 (392)	38.17 (378)	29.24 (784)	66.53 (85)	21.44 (49)	42.16 (252)	49.53 (17)	32.75 (847)
10	44.44 (252)	49.70 (229)	33.71 (421)	99.34 (52)	31.49 (23)	44.46 (99)	40.27 (2)	36.49 (421)
12	55.73 (169)	60.64 (174)	41.59 (420)	57.85 (49)	62.54 (56)	61.45 (94)	73.92 (5)	42.64 (381)
15	50.01 (82)	120.65 (88)	53.03 (284)	120.01 (4)	74.08 (149)	73.26 (7)	110.10 (1)	61.79 (218)
16	---	88.77 (40)	92.08 (14)	93.84 (18)	69.81 (12)	68.17 (112)	---	67.93 (24)
18	37.66 (1)	63.65 (132)	68.03 (208)	89.11 (19)	161.57 (299)	82.80 (109)	---	95.17 (206)
21	78.12 (3)	98.19 (45)	69.14 (104)	163.29 (1)	83.74 (212)	105.92 (4)	---	60.39 (71)
24	82.54 (3)	82.13 (50)	88.66 (120)	188.08 (28)	116.13 (400)	107.26 (97)	44.60 (1)	92.39 (122)
27	---	34.48 (4)	116.56 (22)	---	117.52 (133)	---	---	106.83 (51)
30	---	32.16 (3)	135.47 (31)	114.96 (2)	168.60 (357)	173.36 (48)	---	115.81 (114)
36	---	---	154.74 (18)	109.61 (1)	225.90 (358)	212.61 (24)	---	147.24 (79)
42	---	---	79.47 (3)	---	181.06 (187)	550.52 (11)	---	202.81 (29)
48	---	---	132.95 (4)	---	209.63 (96)	---	---	232.56 (27)
54	---	---	---	---	313.59 (152)	---	---	411.14 (21)
60	---	---	---	---	349.47 (104)	---	---	361.31 (42)
66	---	---	---	---	360.64 (39)	---	---	321.52 (7)
72	---	---	---	---	416.46 (71)	---	---	373.87 (13)
78	---	---	---	---	415.44 (36)	---	---	737.73 (5)
84	---	---	---	---	559.90 (6)	---	---	385.55 (8)
90	---	---	---	---	444.64 (3)	---	---	632.95 (1)
96	---	---	---	---	369.76 (1)	---	---	462.21 (27)
102	---	---	---	---	583.58 (1)	---	---	---
Total No. of Bid Items	963	1162	2568	279	2752	883	30	2935

BY PIPE DEPTH:

BY CLASSIFICATION:

Diameter	0-8 Feet	8-15 Feet	>15 Feet	SMSA	Non-SMSA	National Average
04	13.58 (2)	12.53 (3)	---	16.51 (35)	13.41 (81)	14.37 (116)
06	15.29 (26)	17.99 (65)	23.94 (10)	22.31 (169)	17.40 (209)	19.60 (378)
08	33.28 (323)	36.97 (1233)	45.57 (441)	44.16 (1211)	30.81 (1493)	36.92 (2804)
10	31.18 (224)	48.83 (673)	47.25 (231)	54.69 (714)	36.79 (785)	44.95 (1499)
12	39.58 (190)	45.38 (553)	55.94 (234)	60.28 (656)	43.69 (695)	51.65 (1351)
15	46.27 (127)	58.33 (359)	67.55 (130)	73.18 (420)	57.88 (413)	64.73 (833)
16	61.86 (45)	65.52 (83)	76.93 (38)	70.68 (121)	78.71 (99)	74.97 (220)
18	63.31 (150)	63.11 (413)	82.15 (176)	141.93 (504)	65.32 (475)	106.92 (979)
21	70.14 (57)	89.44 (173)	86.17 (101)	80.46 (101)	72.47 (289)	76.24 (440)
24	83.83 (95)	89.34 (316)	110.57 (200)	115.78 (379)	100.57 (446)	109.67 (825)
27	136.43 (16)	99.75 (58)	7.72 (5)	115.76 (134)	103.97 (76)	111.52 (210)
30	120.01 (61)	117.13 (191)	7.03 (170)	162.28 (344)	125.02 (219)	151.44 (563)
36	154.13 (24)	143.79 (156)	92 (159)	216.42 (316)	168.84 (165)	204.37 (481)
42	170.64 (11)	194.58 (63)	6.39 (77)	164.78 (138)	247.48 (92)	198.81 (230)
48	160.01 (4)	183.62 (20)	246.24 (27)	205.04 (92)	225.85 (35)	210.09 (127)
54	213.56 (8)	286.51 (44)	383.77 (89)	335.74 (148)	270.89 (25)	326.38 (173)
60	652.87 (1)	383.42 (33)	384.11 (65)	348.52 (96)	357.35 (50)	348.11 (146)
66	---	224.85 (1)	314.22 (10)	352.90 (39)	341.90 (7)	353.23 (46)
72	---	272.91 (6)	313.00 (26)	426.02 (65)	372.57 (19)	415.65 (84)
78	---	---	---	496.38 (41)	---	496.38 (41)
84	---	---	---	481.33 (14)	---	481.33 (14)
90	---	---	---	531.59 (4)	---	531.59 (4)
96	---	---	435.23 (25)	466.25 (28)	---	466.25 (28)
102	---	---	---	583.58 (1)	---	583.58 (1)
Total No. of Bid Items	1364	4445	2238	5970	5623	11593

* Includes all non-pipe construction costs and Step 3 nonconstruction costs. Step 1 and 2 costs excluded.

Notes: All costs normalized to Kansas City, MO 1st Qtr 1979
(1 Number of bid items in sample)

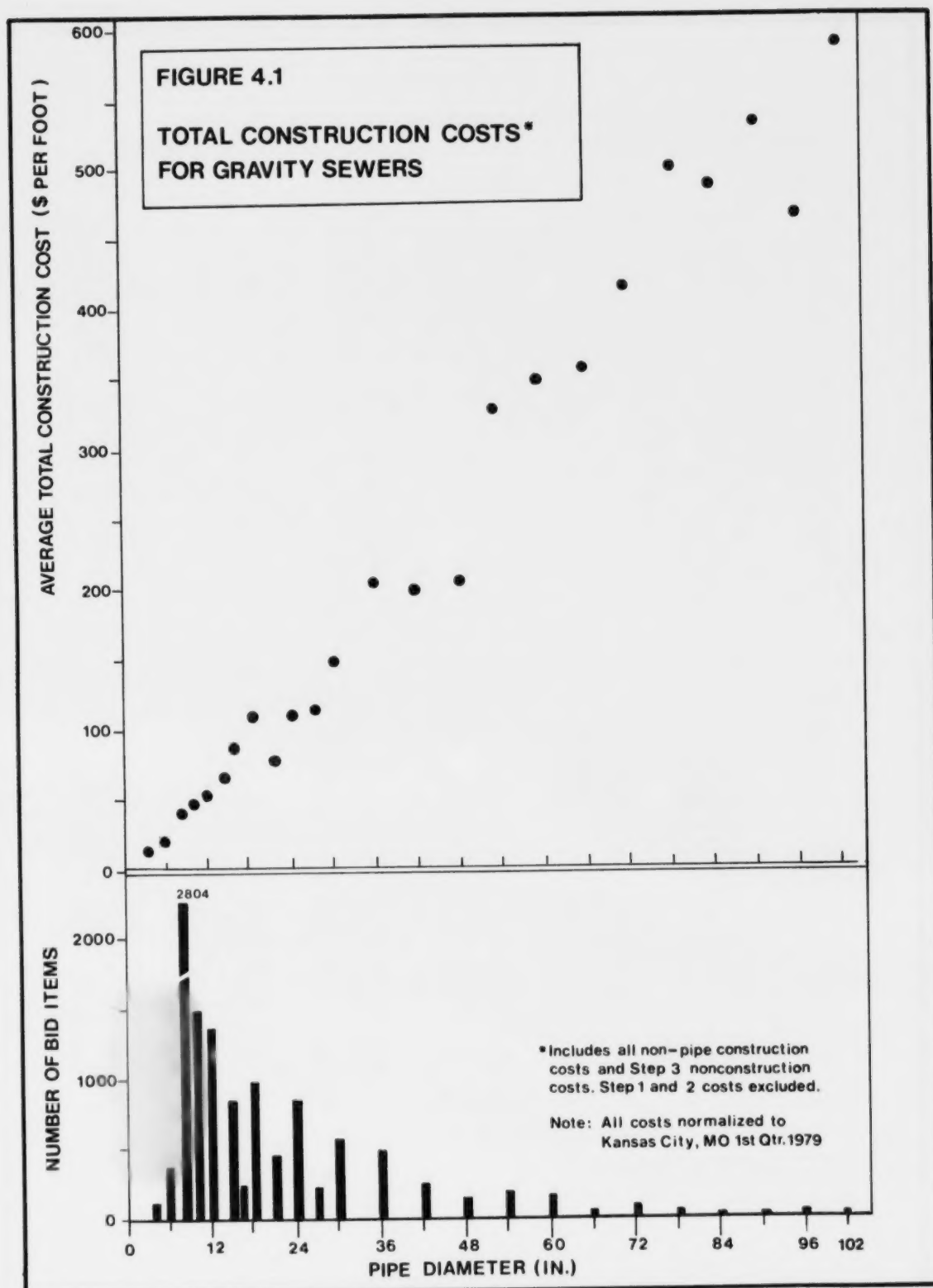


TABLE 4.2
GRAVITY SEWER TOTAL CONSTRUCTION COSTS (\$/FOOT)
PIPE TYPE AND BURIAL DEPTH BY DIAMETER

Diameter	DVC			Asbestos Cement			Vitrified Clay			Cast Iron		
	-8 Feet	8-15 Feet	>15 Feet	-8 Feet	8-15 Feet	>15 Feet	-8 Feet	8-15 Feet	>15 Feet	-8 Feet	8-15 Feet	>15 Feet
04	---	---	---	---	---	---	---	---	---	---	---	---
06	11.95 (5)	13.13 (13)	15.51 (1)	---	21.07 (4)	---	17.35 (11)	20.44 (27)	37.55 (3)	23.94 (1)	19.15 (2)	---
08	25.64 (66)	36.18 (191)	57.88 (71)	29.42 (67)	32.09 (107)	43.45 (74)	24.41 (120)	27.29 (354)	35.53 (144)	198.57 (19)	147.22 (28)	42.34 (1)
10	32.57 (81)	47.12 (122)	71.16 (61)	36.90 (31)	46.61 (117)	46.61 (20)	28.67 (59)	31.30 (210)	42.88 (99)	30.49 (5)	234.72 (18)	49.00 (6)
12	35.01 (27)	55.17 (80)	97.31 (41)	45.36 (23)	44.14 (87)	62.88 (25)	36.08 (53)	40.36 (192)	54.98 (72)	37.77 (4)	56.15 (17)	67.19 (3)
15	47.78 (14)	49.55 (44)	76.20 (17)	42.10 (12)	47.00 (41)	71.67 (25)	48.44 (53)	51.52 (134)	69.49 (30)	---	---	---
16	---	---	---	82.67 (5)	65.49 (21)	85.54 (10)	56.95 (1)	86.50 (8)	77.34 (5)	66.62 (5)	87.45 (6)	---
18	---	---	---	54.32 (23)	58.30 (70)	65.28 (26)	62.02 (27)	63.38 (98)	80.68 (31)	104.92 (1)	82.16 (5)	130.69 (1)
21	---	---	---	66.58 (2)	101.19 (1)	---	62.62 (7)	116.86 (39)	97.72 (14)	---	---	---
24	---	---	---	88.54 (3)	---	---	72.52 (11)	87.46 (51)	104.95 (27)	94.99 (2)	125.92 (5)	---
27	---	---	---	---	---	---	86.90 (3)	90.86 (4)	98.18 (6)	---	---	---
30	---	---	---	---	---	---	107.04 (4)	91.76 (7)	61.50 (4)	---	---	---
36	---	---	---	---	---	---	---	73.06 (1)	86.28 (9)	---	---	---
42	---	---	---	---	---	---	---	---	---	---	---	---
48	---	---	---	---	---	---	---	---	---	---	---	---
54	---	---	---	---	---	---	---	---	---	---	---	---
60	---	---	---	---	---	---	---	---	---	---	---	---
66	---	---	---	---	---	---	---	---	---	---	---	---
72	---	---	---	---	---	---	---	---	---	---	---	---
78	---	---	---	---	---	---	---	---	---	---	---	---
96	---	---	---	---	---	---	---	---	---	---	---	---
Total No. of Bid Items	178	455	194	172	573	100	354	1174	415	37	81	11

Diameter	Reinforced Concrete			Ductile Iron			ABS			Other/Unknown		
	-8 Feet	8-15 Feet	>15 Feet	-8 Feet	8-15 Feet	>15 Feet	-8 Feet	8-15 Feet	>15 Feet	-8 Feet	8-15 Feet	>15 Feet
04	9.87 (1)	12.53 (3)	---	17.30 (1)	---	---	---	---	---	---	---	---
06	11.57 (1)	15.20 (13)	---	24.25 (8)	25.98 (3)	---	---	---	---	---	---	---
08	15.55 (1)	25.01 (1)	35.40 (6)	28.37 (1)	35.05 (8)	51.30 (10)	75.15 (2)	60.43 (9)	72.35 (2)	8.58 (5)	16.76 (13)	16.10 (6)
10	44.89 (3)	53.01 (8)	---	33.37 (20)	42.35 (29)	44.78 (4)	---	---	---	23.24 (142)	30.65 (353)	49.01 (113)
12	33.53 (7)	139.03 (14)	35.15 (3)	47.84 (19)	44.63 (20)	58.76 (9)	144.55 (1)	149.64 (2)	---	34.08 (53)	39.09 (141)	53.32 (7)
15	54.37 (21)	95.69 (57)	56.72 (34)	56.31 (1)	60.03 (4)	---	---	---	---	41.33 (26)	46.63 (79)	51.35 (24)
16	95.56 (4)	69.05 (3)	69.17 (6)	59.39 (27)	61.78 (38)	78.19 (16)	---	---	---	46.44 (5)	42.16 (9)	51.61 (1)
18	71.47 (28)	100.45 (91)	79.50 (54)	98.21 (2)	75.02 (32)	114.54 (24)	---	---	---	33.26 (28)	58.49 (74)	79.91 (30)
21	71.47 (28)	100.45 (91)	79.50 (54)	98.21 (2)	75.02 (32)	114.54 (24)	---	---	---	67.11 (8)	63.72 (41)	142.31 (22)
24	86.63 (42)	87.75 (155)	100.04 (119)	100.20 (23)	121.74 (34)	137.23 (19)	44.40 (1)	---	---	---	---	---
27	119.00 (12)	110.07 (36)	116.68 (38)	---	---	---	---	---	---	219.08 (3)	75.05 (18)	81.12 (9)
30	115.06 (29)	117.07 (130)	132.33 (135)	157.73 (12)	167.22 (18)	188.34 (10)	---	---	---	114.38 (9)	115.15 (35)	106.92 (21)
36	124.59 (10)	163.34 (51)	214.18 (67)	573.41 (1)	585.60 (4)	615.93 (4)	---	---	---	181.57 (3)	128.96 (22)	153.20 (15)
42	178.26 (3)	190.62 (15)	246.29 (27)	---	---	---	---	---	---	126.51 (1)	166.37 (5)	---
48	---	---	---	---	---	---	---	---	---	---	---	---
54	213.56 (8)	285.92 (38)	362.12 (79)	---	---	---	---	---	---	---	468.60 (6)	497.12 (10)
60	652.87 (1)	257.72 (25)	353.33 (49)	---	---	---	---	---	---	---	506.47 (8)	526.15 (16)
66	---	---	---	---	---	---	---	---	---	---	---	---
72	---	287.72 (5)	333.56 (22)	---	---	---	---	---	---	---	---	---
78	---	---	---	---	---	---	---	---	---	---	---	---
96	---	---	---	---	---	---	---	---	---	---	---	---
Total No. of Bid Items	237	908	845	215	286	100	4	11	2	349	1705	469

* Includes all non-pipe construction costs and Step 3 nonconstruction costs. Step 1 and 2 costs excluded.
Notes: () All costs normalized to Kansas City, MO 1st Qtr 1979
() Number of bid items in sample

Bare Pipe Costs

Bare pipe costs are defined herein to be the costs for materials and labor to install and backfill the pipe. Appurtenances, manholes, etc., and Step 3 nonconstruction costs are not included in these figures. Step 1 and 2 costs are also excluded. These costs, therefore, are only one component of the total construction costs for gravity sewers as presented in Tables 4.1 and 4.2.

Table 4.3 summarizes the bare pipe costs by pipe type, depth of burial, and SMSA classification in the same manner done for total construction costs in Table 4.1. This summary includes the identical data base presented previously for total construction costs.

As would be expected, the same general trends are apparent as for the total construction costs. Figure 4.2 graphically depicts these data to indicate the trends for the national average costs.

Some bid documents broke out the cost of pipe and labor as separate components. These data were analyzed to the degree the sample permitted. Table 4.4 summarizes the 816 bid items which delineated the cost of the pipe delivered to the site. Insufficient data were available to summarize the results by type of pipe or depth of burial. The sample size presents some anomalies, but the trends are consistent with those of the larger data base.

Somewhat more data were available for the labor required to install the pipe. An analysis was made of 1,009 bid items in this category and is summarized in Table 4.5. These data have been broken down into depth of burial and SMSA classifications. As would be expected, the data reveal labor costs for similar bid items are higher in the SMSA's.

The sum of the pipe and labor costs (Tables 4.4 and 4.5) should equal the bare-in-place pipe costs (Table 4.3). For most cases, particularly for smaller diameter pipe, the sum is greater than either the bare-in-place costs or the total construction costs. The cause of this is attributed primarily to

TABLE 4.3

GRAVITY SEWER BARE-IN-PLACE CONSTRUCTION COSTS* (\$/FOOT) PIPE TYPE, BURIAL DEPTH, AND SMSA CLASSIFICATION BY DIAMETER

BY PIPE TYPE:

Diameter	PVC	Asbestos Cement	Vitrified Clay	Cast Iron	Reinforced Concrete	Ductile Iron	ABS	Other/ Unknown
04	13.46 (18)	8.91 (6)	10.22 (16)	9.04 (5)	10.50 (4)	16.05 (4)	11.79 (2)	13.17 (61)
06	9.79 (43)	12.86 (13)	13.00 (119)	16.44 (15)	10.48 (4)	18.25 (22)	12.16 (2)	11.59 (160)
08	21.81 (392)	23.52 (378)	19.90 (784)	27.41 (85)	15.78 (49)	28.21 (252)	25.65 (17)	22.37 (847)
10	23.76 (252)	23.01 (229)	20.97 (421)	29.70 (52)	19.65 (23)	31.42 (99)	17.97 (2)	23.18 (421)
12	25.52 (169)	27.59 (174)	25.61 (420)	39.28 (49)	20.51 (56)	35.83 (94)	27.58 (5)	27.18 (381)
15	30.18 (82)	30.19 (88)	30.05 (284)	83.38 (4)	29.66 (149)	39.10 (7)	33.17 (1)	38.93 (218)
16	---	45.70 (40)	33.87 (14)	55.30 (18)	54.61 (12)	40.71 (112)	---	37.89 (24)
18	12.24 (1)	26.67 (132)	36.55 (208)	53.13 (19)	42.32 (299)	49.91 (109)	---	35.30 (206)
21	49.17 (3)	37.54 (45)	41.41 (104)	142.13 (1)	48.99 (212)	62.60 (4)	---	33.33 (71)
24	44.72 (3)	38.63 (50)	51.57 (120)	135.85 (28)	46.56 (400)	70.57 (97)	19.25 (1)	51.89 (122)
27	---	25.34 (4)	72.18 (22)	---	55.43 (133)	---	---	57.85 (51)
30	---	26.63 (3)	71.63 (31)	62.87 (2)	65.58 (357)	100.34 (48)	---	73.34 (114)
36	---	---	75.05 (18)	75.22 (1)	85.80 (358)	157.49 (24)	---	91.94 (79)
42	---	---	64.53 (3)	---	111.89 (187)	434.50 (11)	---	122.81 (29)
48	---	---	71.46 (4)	---	114.07 (96)	---	---	147.09 (27)
54	---	---	---	---	216.42 (152)	---	---	257.19 (21)
60	---	---	---	---	198.31 (104)	---	---	249.25 (42)
66	---	---	---	---	186.83 (39)	---	---	262.04 (7)
72	---	---	---	---	248.10 (71)	---	---	230.83 (13)
78	---	---	---	---	253.21 (36)	---	---	466.25 (5)
84	---	---	---	---	352.74 (6)	---	---	318.19 (8)
90	---	---	---	---	216.52 (3)	---	---	564.33 (1)
96	---	---	---	---	239.46 (1)	---	---	366.15 (27)
102	---	---	---	---	304.47 (1)	---	---	---
Total No. of Bid Items	963	1162	2568	279	2752	883	30	2935

BY PIPE DEPTH:

Diameter	BY PIPE DEPTH:			BY CLASSIFICATION:		
	<8 Feet	8-15 Feet	>15 Feet	SMSA	Non-SMSA	National Average
04	11.86 (2)	11.17 (3)	---	14.68 (35)	11.41 (81)	12.40 (116)
06	11.28 (26)	12.98 (65)	18.66 (10)	13.99 (169)	11.20 (209)	12.45 (378)
08	17.18 (523)	21.14 (1233)	33.89 (441)	23.90 (1311)	20.96 (1493)	22.34 (2804)
10	17.41 (224)	20.53 (673)	33.75 (251)	23.99 (714)	22.74 (785)	23.34 (1499)
12	22.27 (190)	23.15 (553)	38.50 (234)	27.20 (656)	27.42 (695)	27.31 (1351)
15	22.67 (127)	27.35 (359)	40.66 (130)	30.09 (420)	35.29 (413)	32.67 (833)
16	39.94 (45)	38.75 (83)	50.33 (38)	44.02 (121)	41.37 (99)	42.83 (220)
18	31.14 (150)	33.88 (415)	51.59 (176)	40.27 (504)	36.61 (475)	38.49 (979)
21	35.51 (57)	49.57 (173)	47.53 (101)	47.28 (201)	40.95 (239)	43.84 (440)
24	42.74 (95)	45.48 (316)	63.86 (200)	47.34 (379)	58.54 (446)	53.39 (629)
27	74.11 (16)	49.42 (58)	61.23 (54)	57.88 (134)	56.00 (76)	57.20 (210)
30	61.39 (61)	63.49 (191)	74.29 (170)	67.64 (344)	73.65 (219)	69.98 (563)
36	91.55 (24)	78.68 (156)	99.71 (159)	83.36 (316)	102.33 (165)	89.87 (481)
42	104.57 (11)	121.69 (63)	169.07 (77)	92.93 (138)	180.80 (92)	128.08 (230)
48	84.78 (4)	88.25 (20)	129.51 (27)	116.39 (92)	128.57 (35)	119.75 (127)
54	119.50 (8)	176.56 (44)	251.57 (89)	229.57 (148)	172.83 (25)	221.37 (173)
60	470.39 (1)	221.12 (33)	226.85 (65)	214.28 (96)	210.42 (50)	212.96 (146)
66	---	94.68 (1)	181.75 (10)	196.68 (39)	207.13 (7)	198.27 (46)
72	---	159.21 (6)	199.38 (26)	255.14 (65)	212.18 (19)	245.43 (84)
78	---	---	---	279.19 (41)	---	279.19 (41)
84	---	---	---	333.00 (14)	---	333.00 (14)
90	---	---	---	303.47 (4)	---	303.47 (4)
96	---	---	348.35 (25)	361.63 (28)	---	361.63 (28)
102	---	---	---	304.47 (1)	---	304.47 (1)
Total No. of Bid Items	1564	4445	2283	5970	5623	11593

* Sten 1 and 2 costs, Sten 3 nonconstruction costs, and non-pipe construction costs excluded.

*Notes: All costs normalized to Kansas City, MO 1st Qtr 1979
() Number of bid items in sample

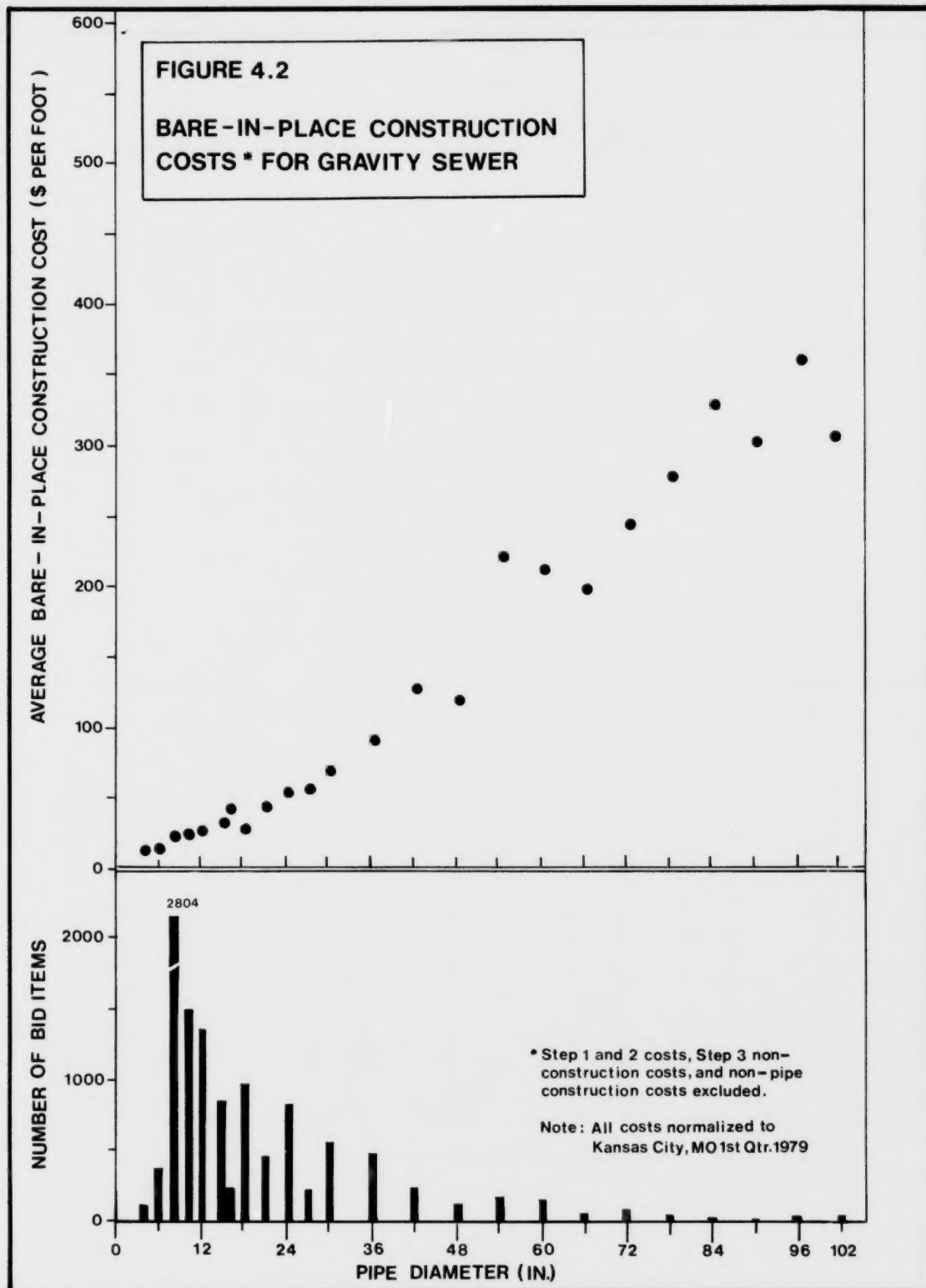


TABLE 4.4

GRAVITY SEWER PIPE COSTS
DELIVERED TO SITE (\$/FOOT)

<u>Diameter</u>	<u>SMSA</u>	<u>Non-SMSA</u>	<u>National Average</u>
04	8.80 (4)	7.48 (11)	7.83 (15)
06	11.05 (12)	7.88 (25)	8.91 (37)
08	13.25 (84)	7.98 (78)	10.71 (162)
10	16.21 (47)	8.01 (39)	12.49 (86)
12	14.96 (57)	14.33 (41)	14.70 (98)
15	18.44 (44)	13.44 (22)	16.78 (66)
16	20.07 (16)	24.20 (13)	21.92 (29)
18	20.91 (48)	15.63 (29)	18.92 (77)
21	26.60 (28)	17.64 (10)	24.24 (38)
24	27.77 (39)	29.01 (14)	28.10 (53)
27	25.22 (8)	33.10 (7)	28.90 (15)
30	46.24 (23)	58.53 (4)	48.06 (27)
36	45.65 (29)	57.35 (10)	48.65 (39)
42	46.24 (8)	75.68 (2)	52.13 (10)
48	68.28 (13)	---	68.28 (13)
54	63.75 (13)	---	63.75 (13)
60	68.43 (20)	---	68.43 (20)
66	91.44 (18)	---	91.44 (18)
Total No. of Bid Items	511	305	816

Note: All costs normalized to Kansas City, MO 1st Qtr 1979

TABLE 4.5
GRAVITY SEWER CONSTRUCTION LABOR COSTS
\$/FOOT OF PIPE INSTALLED

Diameter	SMSA			Non-SMSA			National Average		
	<8 Feet	8-15 Feet	>15 Feet	<8 Feet	8-15 Feet	>15 Feet	<8 Feet	8-15 Feet	>15 Feet
04	---	9.49 (5)	---	---	---	---	---	9.49 (5)	---
06	---	10.25 (2)	---	---	---	---	---	10.25 (2)	---
08	9.33 (4)	27.74 (34)	99.26 (9)	---	---	---	9.91 (7)	21.64 (59)	47.60 (20)
10	10.82 (1)	13.19 (5)	---	10.70 (3)	13.36 (25)	5.33 (11)	10.82 (1)	17.42 (8)	---
12	12.96 (1)	23.73 (17)	54.98 (7)	---	24.48 (3)	---	7.76 (2)	20.32 (22)	42.38 (11)
15	---	20.20 (15)	---	2.57 (1)	8.74 (5)	20.18 (4)	---	---	---
16	---	155.86 (2)	---	---	---	---	---	20.20 (15)	---
18	4.32 (1)	24.24 (34)	155.86 (2)	---	---	---	---	155.86 (2)	155.86 (2)
21	11.13 (1)	14.08 (2)	30.41 (16)	---	18.12 (9)	24.91 (9)	4.32 (1)	21.38 (43)	28.43 (25)
24	10.48 (2)	15.97 (18)	20.84 (3)	---	3.89 (4)	6.74 (5)	11.13 (1)	7.29 (6)	---
27	9.28 (1)	17.47 (11)	33.74 (20)	---	---	4.15 (4)	10.48 (2)	15.97 (18)	28.81 (24)
30	6.64 (2)	16.42 (10)	64.44 (16)	2.64 (1)	4.96 (4)	7.36 (2)	5.96 (2)	14.13 (15)	58.10 (18)
36	15.63 (1)	36.82 (18)	34.29 (16)	---	3.41 (7)	7.83 (10)	6.64 (2)	11.06 (17)	24.11 (28)
42	---	41.17 (3)	67.52 (26)	12.19 (2)	13.94 (12)	21.15 (23)	13.33 (3)	27.67 (30)	45.75 (49)
48	---	55.45 (5)	62.54 (2)	---	---	12.83 (6)	---	41.17 (3)	25.25 (8)
54	---	64.17 (7)	179.12 (6)	---	---	---	---	55.45 (5)	179.12 (6)
60	22.34 (1)	26.25 (2)	63.70 (20)	---	---	---	---	64.17 (7)	63.70 (20)
			186.48 (8)	---	---	---	22.34 (1)	26.25 (2)	186.43 (8)
Total No. of Bid Items	15	190	151	7	69	77	22	259	219

*Notes: All costs normalized to Kansas City, MO 1st Qtr 1979
() Number of bid items in sample

the labor costs. Labor often is broken out separately on projects requiring special skills or inordinate time.

Non-Pipe Costs for Gravity Sewers

Construction costs for non-pipe items which are part of the total project are often itemized separately by the contractors bidding on a job. Table 4.6 summarizes the bid items for the ten most common non-pipe construction cost items. These numbers represent the cost of the items as a percentage of the bare-in-place pipe costs on a national basis. If all categories were required for all projects, 46 percent of the bare pipe costs would be indicated. This percentage also was calculated for the total national data base by adding all the non-pipe construction costs associated with gravity sewers and dividing that total by all the gravity sewer construction costs. The resulting number is 43.7 percent. Over 10,000 individual bid items were used in this analysis.

Considerable data on non-pipe costs are presented in the Appendices. Tables C.1, C.2, and C.3 have non-pipe costs by diameter of pipe for SMSA, non-SMSA, and combined projects. Tables in Appendix D summarize the non-pipe construction costs by diameter of pipe for each type of material. Tables in Appendices E and F present the same data for various depths of burial.

The most common non-pipe construction bid item in the data base is for manholes. These data were analyzed and are presented in Table 4.7 for regular manholes and Table 4.8 for drop manholes. The data are presented by depth range and for SMSA and non-SMSA locations, as well as the national averages.

These tables present some anomalies when examined in detail. Of these, the most conspicuous is the nearly uniform fact that manholes 8-15 feet deep have a lower cost than those less than 8 feet in depth.

Other non-pipe construction costs were examined in detail but statistically valid or useful information was not produced.

TABLE 4.6

NON-PIPE CONSTRUCTION COST FOR GRAVITY SEWER
AS PERCENTAGE OF BARE-IN-PLACE PIPE COST

<u>Category</u>	<u>SMSA</u>	<u>Non-SMSA</u>	<u>National Average</u>
Sanitary Sewer Appurtenances	1	1	1 (340)
Thoroughfare Crossings	8	4	6 (376)
Stream Crossings	4	4	4 (145)
Rock Excavation	6	7	6 (183)
Pavement Replacement	8	6	7 (426)
Utility Reconnection	2	1	2 (63)
Special Bedding & Backfill	7	3	5 (336)
Mobilization & Miscellaneous	9	6	8 (512)
Manholes	5	5	5 (602)
Drop Manholes	3	1	2 (249)
			—
Total No. of Bid Items			3232

Note: Numbers in parentheses indicate the number of bid items,
not the number of actual units.

TABLE 4.7

AVERAGE UNIT CONSTRUCTION COST OF MANHOLES* (\$/UNIT)
BY DIAMETER, DEPTH, AND SMSA CLASSIFICATION

<u>Diameter</u>	<u>Depth of Manholes</u>		
	<u><8 Feet</u>	<u>8-15 Feet</u>	<u>>15 Feet</u>
<u>SMSA Projects:</u>			
48	902.46 (363)	800.98 (190)	1664.82 (107)
60	1847.66 (118)	1709.43 (65)	2225.71 (68)
72	2179.67 (29)	1621.37 (22)	3156.20 (20)
Unknown/ Other	2166.56 (40)	1982.13 (20)	4305.70 (11)
<u>Non-SMSA Projects:</u>			
48	786.21 (340)	868.62 (161)	1488.83 (64)
60	1512.58 (57)	1612.96 (26)	5633.65 (6)
72	2504.92 (31)	2848.38 (9)	---
Unknown/ Other	5426.95 (26)	2825.49 (27)	3695.26 (18)
<u>National Average:</u>			
48	846.08 (703)	832.01 (351)	1587.15 (171)
60	1738.52 (175)	1681.87 (91)	2502.03 (74)
72	2347.72 (60)	1977.60 (31)	3156.20 (20)
Unknown/ Other	3450.96 (66)	2466.61 (47)	3926.81 (29)

* Step 3 nonconstruction costs excluded

Notes: All costs normalized to Kansas City, MO 1st Qtr 1979
Numbers in parentheses indicate the number of bid
items, not the number of manholes.

TABLE 4.8

AVERAGE UNIT CONSTRUCTION COST OF DROP MANHOLES* (\$/UNIT)
BY DIAMETER, DEPTH, AND SMSA CLASSIFICATION

Diameter	Depth of Manholes		
	<8 Feet	8-15 Feet	>15 Feet
<u>SMSA Projects:</u>			
48	1348.55 (49)	1169.64 (20)	4718.70 (24)
60	3367.09 (7)	2325.20 (5)	2774.85 (10)
72	3833.00 (1)	1783.50 (2)	4557.62 (9)
Unknown/ Other	2070.56 (18)	---	---
<u>Non-SMSA Projects:</u>			
48	1174.11 (52)	1100.71 (24)	1589.34 (9)
60	1870.89 (15)	2194.83 (3)	---
72	2970.17 (1)	---	---
Unknown/ Other	1573.80 (9)	4128.50 (2)	3508.00 (4)
<u>National Average:</u>			
48	1258.74 (101)	1132.04 (44)	3865.24 (33)
60	2346.95 (22)	2276.31 (8)	2774.85 (10)
72	3401.58 (2)	1783.50 (2)	4557.62 (9)
Unknown/ Other	1904.97 (27)	4128.50 (2)	3508.00 (4)

* Step 3 nonconstruction costs excluded

Notes: All costs normalized to Kansas City, MO 1st Qtr 1979
Numbers in parentheses indicate the number of bid
items, not the number of drop manholes.

COSTS FOR FORCE MAINS

The terms force mains and pressure sewers were used synonymously and all data were aggregated under force mains. The data base contains 1,085 individual bid items for force mains. These force mains were, in all but a few cases, a single bid item in a much larger project containing gravity sewers and other non-pipe construction costs. Therefore, bare-in-place force main costs were readily obtainable. Table 4.9 summarizes the 1,085 force main bid items for the nation. Bare-in-place costs are presented for each diameter of force main in place. Figure 4.3 graphically presents the same information. Because of the relatively small data base, individual variations in the cost data are more pronounced than for those presented for gravity sewers.

Non-pipe construction costs were separately identified in the data base when available. Analysis of these data resulted in inconclusive ratios. In an attempt to arrive at a trend for the total non-pipe construction costs, the national data base was examined. The total force main bare-in-place construction costs were divided into all non-pipe construction costs associated with these mains. The result indicated, on a national basis, the non-pipe construction costs were 25.7 percent of the bare-in-place costs. The fact that this number is 18 percentage points lower than gravity sewers is realistic since the construction of a force main is normally less complicated than a gravity sewer.

COSTS FOR PUMP STATIONS

The total construction costs of municipal wastewater pump stations were often available from the bid tabulations. Figure 4.4 presents a graph of the pump capacity in gallons per minute (gpm) versus cost in thousands of dollars for three ranges of total dynamic head (TDH) in feet. The costs presented in Figure 4.4 include the cost for the basic pump station in place, as well as the appurtenances and other construction costs associated with the pump station. Step 3 nonconstruction costs and Step 1 and 2 engineering costs are not included.

It should be noted that the design capacity for pump stations in Figure 4.4 is defined as the average design capacity for the facility and not the total

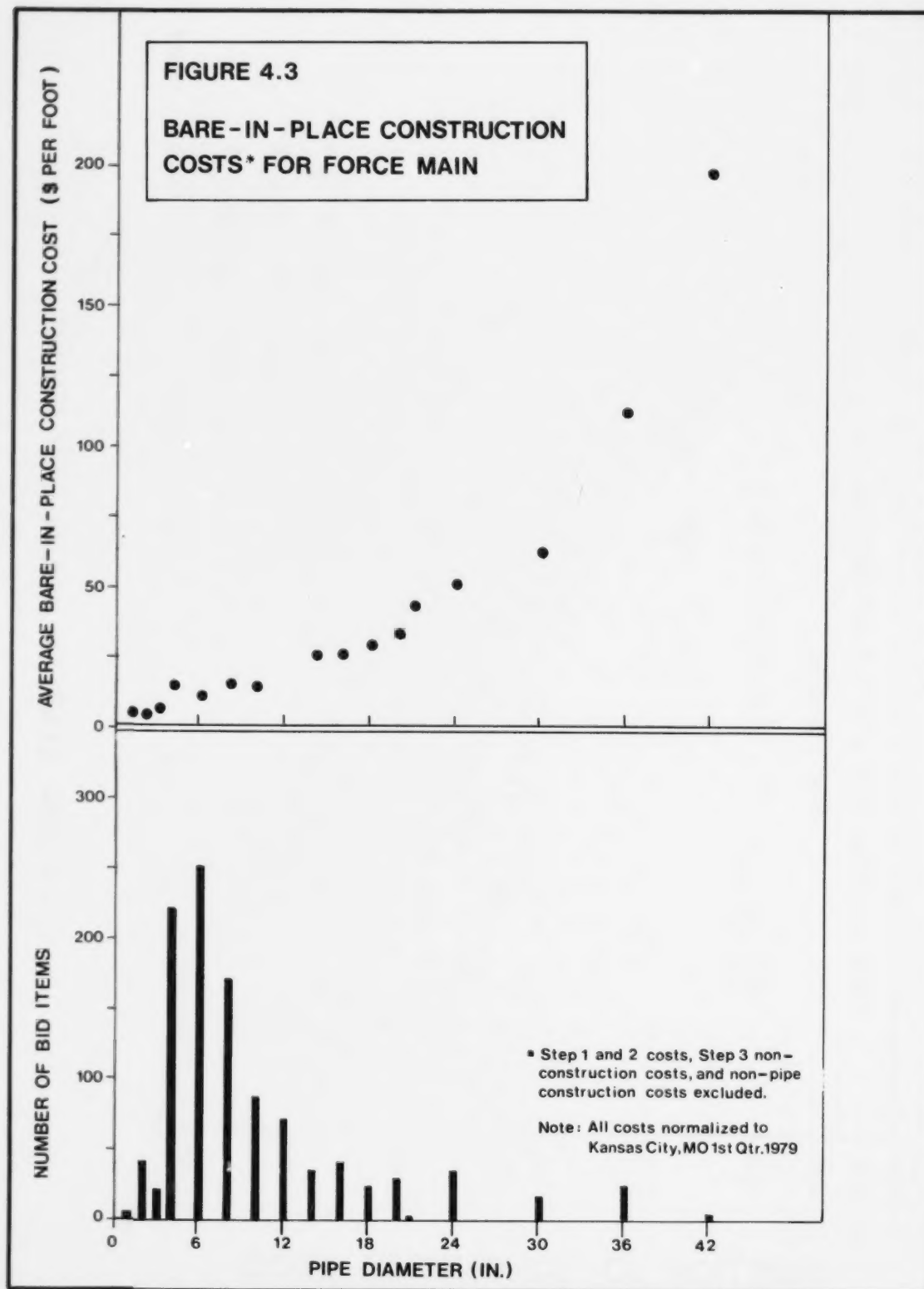
TABLE 4.9
FORCE MAIN BARE-IN-PLACE CONSTRUCTION COSTS* (\$/FOOT)

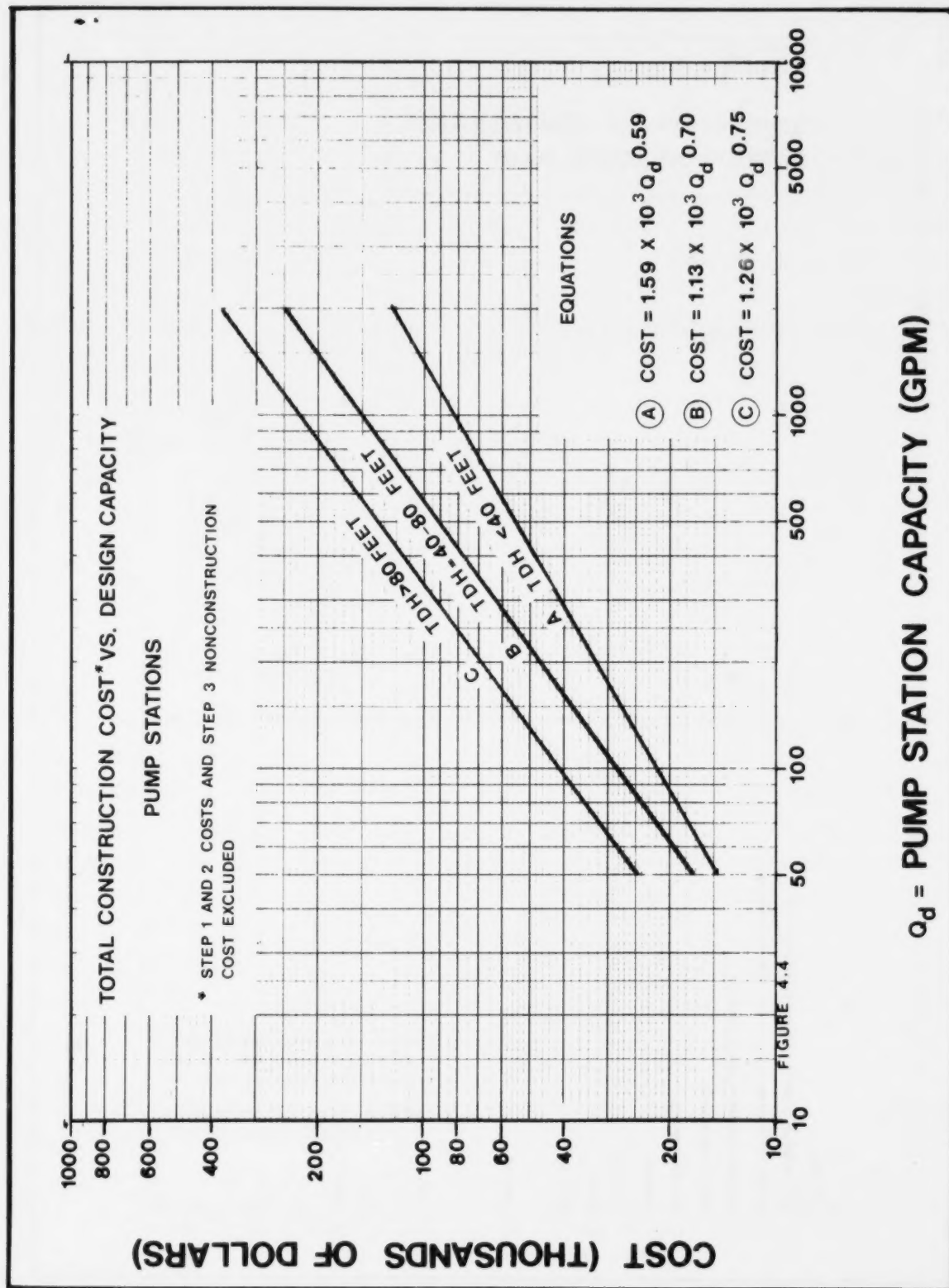
<u>Diameter</u>	<u>National Average Cost</u>
1	4.93 (7)
2	4.23 (42)
3	5.77 (21)
4	14.28 (221)
6	10.39 (251)
8	14.89 (172)
10	14.26 (88)
12	31.20 (71)
14	26.00 (36)
16	25.48 (41)
18	29.28 (25)
20	33.40 (30)
21	43.06 (1)
24	51.44 (34)
30	63.11 (17)
36	113.30 (24)
42	198.14 (4)
Total No. of Bid Items	1085

National Average non-pipe construction cost for force mains is 25.7 percent of bare-in-place costs.

* Step 1 and 2 costs, Step 3 nonconstruction costs, and non-pipe construction costs excluded.

Note: All costs normalized to Kansas City, MO 1st Qtr 1979.





Q_d = PUMP STATION CAPACITY (GPM)

installed pumping capacity. Since proper performance of pumping equipment is critical to the operation of a wastewater collection system, multiple pumps are usually installed in all but the smallest pump stations. Generally the pump stations in the data base used to derive Figure 4.4 will produce the stated capacity with the largest installed pump out of service.

Non-pump station construction costs for the national data base were calculated in a manner analogous to gravity sewers and force mains. The non-pump station construction costs are 5.0 percent of the pump station construction costs. This low percentage, as compared with sewers, is expected since most pump stations are bid complete, with only occasional requirements for special or unusual items bid separately.

NONCONSTRUCTION COSTS

Grant eligible nonconstruction costs related to EPA funded projects consist of Step 1 preliminary engineering costs, Step 2 detailed engineering costs, and Step 3 nonconstruction costs for engineering services and administrative fees related to the construction phase of the project.

Table 4.10 presents the ratios of Step 1 and Step 2 costs to the total construction cost for the wastewater collection systems in the data base. These data are taken from projects involving only the construction of wastewater collection systems and which had received both a Step 1 and 2 grant. The data indicate that the national average Step 1 and 2 costs are approximately five percent and ten percent, respectively, of the total construction cost for collection system projects. The reason the number of facilities in the sample is so low is because most projects have both sewer and treatment plants as part of the Step 1 and/or Step 2 grants.

The ratios of Step 3 nonconstruction costs to the construction costs for projects in the wastewater collection system data base are presented in Table 4.11. Data are presented for facilities inside and outside SMSA areas. The data indicate that the national average Step 3 nonconstruction costs are equal to approximately 36 percent of the total construction costs.

TABLE 4.10

STEP 1 AND STEP 2 COSTS AS A FRACTION OF
TOTAL CONSTRUCTION COSTS - SANITARY SEWER FACILITIES ONLY

<u>Region</u>	<u>Average Step 1/TCC</u>	<u>Average Step 2/TCC</u>	<u>No. of Bid Items</u>
01	---	---	0
02	.0177	.0145	1
03	---	---	0
04	.3227	.0457	1
05	.0288	.0961	5
06	.0439	.0525	6
07	.0436	.1219	10
08	.0670	.1335	6
09	.0175	.0337	4
10	.0667	.1116	4
TOTAL			— 37

Weighted Average:

SMSA	.0718	.0956
Non-SMSA	.0382	0.1384
National	.0520	.0978

* Developed from data for sanitary sewer facilities with both
Step 1 and Step 2 grants for sewer construction only.

TABLE 4.11

STEP 3 NONCONSTRUCTION COSTS AS A FRACTION OF
TOTAL CONSTRUCTION COSTS - SANITARY SEWER FACILITIES ONLY

<u>Nonconstruction Item</u>	<u>SMSA Average</u>	<u>Non-SMSA Average</u>	<u>National Average</u>
Administrative/Legal	.0096 (318)	.0114 (336)	.0101 (654)
Preliminary	.0093 (35)	.0109 (18)	.0095 (53)
Land, Structures, Right of Way	.0266 (21)	.0176 (24)	.0213 (45)
Architect/Engineer Basic Fees	.0673 (349)	.0664 (308)	.0667 (657)
Other Architect/ Engineer Fees	.0329 (174)	.0310 (181)	.0323 (355)
Project Inspection	.0397 (125)	.0484 (152)	.0432 (277)
Land Development	---	.0098 (1)	.0098 (1)
Relocation Expenses	.0024 (1)	---	.0024 (1)
Relocation Payments	.0039 (2)	---	.0039 (2)
Demolition & Removal	.0006 (1)	---	.0006 (1)
Bond Interest	.0353 (6)	.0296 (11)	.0326 (17)
Contingencies	.0487 (359)	.0441 (341)	.0472 (700)
Indirect Costs	.0122 (17)	.0083 (8)	.0118 (25)
Miscellaneous	.0312 (55)	.0158 (36)	.0261 (91)
Equipment	.0215 (14)	.0682 (13)	.0391 (27)
Average Total			
Step 3 NCC/TCC:	.3372 (1477)	.3615 (1429)	.3566 (2906)

Note: () Number of projects with nonconstruction items in Step 3
grant awards

The use of 36 percent would result in an excessively high value for Step 3 nonconstruction costs. The individual percentages accurately represent the cost for that item. However, not all projects had all items, thus using the sum of all is misleading. A more reasonable, but subjective, estimate is derived by totaling the percentages for the most commonly occurring items: administrative/legal services, A/E basic fees, other A/E fees, project inspection, and contingencies. These total approximately 20 percent of the construction costs.

An analysis of the complete data base was performed to determine a national trend for Step 3 nonconstruction costs. All Step 3 nonconstruction costs were divided by all construction costs for the complete data base. The resulting number was 0.174. Thus, 17.4 percent of the construction costs is the national average for Step 3 nonconstruction costs. Similarly, 1.174 times the construction costs equals the total construction costs as defined in this study. Without better information, the reader should use a percentage of 17.4. If special or unusual conditions are known to exist, various nonconstruction cost items found in Table 4.11 can be added.

The total project costs are the sum of the Step 1 and 2 costs presented in Table 4.10, Step 3 nonconstruction costs of Table 4.11, or variances presented above, plus the construction costs for pipe or pump stations. Examples of calculating these costs are presented at the end of this section.

COST UPDATING PROCEDURES

The construction cost data utilized for this report were obtained from projects with bid dates falling between 1973 and 1979. In order to make the information suitable for statistical analysis, the costs were normalized to a single point in time, the first quarter of 1979. To account for regional cost variations, all data were further normalized to a single location, Kansas City, Missouri. These techniques were performed on all the data before any analysis work commenced. The techniques and rationale for these normalizations are explained in detail in Appendix A. The primary purpose of this section is to explain the use of the indexes.

The EPA publishes, on a quarterly frequency, the Complete Urban Sewer System Index (CUSS). The Journal of the Water Pollution Control Federation routinely publishes this same information. The reader using the data presented in this report will certainly want to make estimates in present dollars, or at least those of the most recent quarter available. The CUSS Indexes for 1979 and the first two quarters of 1980 are presented in Table 4.12. Since all costs presented in this report were normalized to Kansas City first quarter 1979, the CUSS Index number upon which all data are based is 170. The cost for any of the other 24 cities for a particular item can be found by using the following formula:

$$\text{Cost (City x, Time t)} = \frac{\text{Cost Item (K.C., MO, 1st Qtr 1979)} \times \text{CUSS Index (City x, Time t)}}{170}$$

The following example is presented on the use of the indexing procedure:

The total construction cost of 24 inch gravity reinforced concrete sewer for Atlanta, Georgia in the first quarter of 1980 is to be determined.

$$\begin{aligned} \text{1st Qtr 1979 24" RCP Sewer Cost} &= \$116.13/\text{ft. (Table 4.1)} \\ \text{CUSS Index, Atlanta, GA 1st Qtr 1980} &= 145 \text{ (Table 4.12)} \\ \text{Atlanta Cost (1st Qtr 1980)} &= \frac{(\$116.13)(145)}{170} = \$99.05/\text{ft.} \end{aligned}$$

The same pipe in Chicago, Illinois would cost:

$$\text{Chicago Cost (1st Qtr 1980)} = \frac{(\$116.13)(213)}{170} = \$145.50/\text{ft.}$$

The 25 CUSS Index cities are located in all regions of the country. However, most readers will require the cost information for one particular area. An elaborate analysis, explained in Appendix A, was used to define the surrounding geographic area which each of the 25 cities has a predominant influence over. The map, Figure A.1, found in Appendix A, should be used to select the city code. For example, Omaha, Nebraska is in area 110. Denver, Colorado CUSS Index would be used.

COST ESTIMATING EXAMPLES

A number of examples are presented to illustrate the use of the cost information presented in this report. These cost estimating techniques are useful when some design information is available.

TABLE 4.12
COMPLETE URBAN SEWER SYSTEM COST INDEX (CUSS)
FROM EPA

City		1979				1980	
Code	Name	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	1st Qtr	2nd Qtr
101	Atlanta, GA	127	130	136	137	145	147
102	Baltimore, MD	153	158	160	161	165	168
103	Birmingham, AL	122	131	136	137	142	142
104	Boston, MA	175	179	180	192	191	191
105	Charolotte, NC	92	98	103	106	111	111
106	Chicago, IL	187	195	207	209	213	213
107	Cincinnati, OH	178	180	186	186	192	192
108	Cleveland, OH	184	187	195	199	205	205
109	Dallas, TX	113	114	121	123	129	129
110	Denver, CO	132	135	151	155	159	160
111	Detroit, MI	184	189	190	190	198	199
112	Houston, TX	129	130	133	135	140	142
113	Kansas City, MO	170	183	185	187	191	191
114	Los Angeles, CA	185	188	203	212	214	214
115	Miami, FL	136	137	140	144	152	153
116	Milwaukee, WI	170	177	187	190	195	195
117	Minneapolis, MN	154	156	167	167	171	173
118	New Orleans, LA	158	159	162	164	168	167
119	New York, NY	210	211	215	222	225	229
120	Philadelphia, PA	192	193	199	200	203	205
121	Pittsburgh, PA	172	172	176	180	185	191
122	St. Louis, MO	192	200	205	206	213	213
123	San Francisco, CA	176	177	195	197	201	208
124	Seattle, WA	185	188	191	191	194	200
125	Trenton, NJ	177	180	185	187	188	188

Example No. 1

An estimate is needed for the total construction cost of 4,000 ft. of 8 inch gravity sewer in Tucson, Arizona. The project is in a very preliminary stage and no details are known for appurtenances, special conditions, or depth of burial.

- a. From Table 4.1, cost of 8" pipe in an SMSA = \$44.16/ft.
- b. From Table 4.12 and Figure A.1, use Denver, CO CUSS Index = 159
- c. Tucson, AZ (1980 cost) = $\frac{(\$44.16)(159)}{170} = \$41.30/\text{ft.}$
- d. Total Construction Cost = \$41.30/ft. x 4,000 ft. = \$165,200

Note: This cost provides an allowance for Step 3 nonconstruction costs and non-pipe construction costs. Step 1 and Step 2 costs are excluded.

Example No. 2

A project near Tucson, Arizona of a very similar nature to that in Example No. 1 is to be constructed. However, more technical information is known about the project. An estimate of the total project cost is required. The following data are known:

Reinforced Concrete Pipe, <8 ft. burial : 1,000 ft.
Reinforced Concrete Pipe, 8-15 ft. burial : 2,000 ft.
Reinforced Concrete Pipe, >15 ft. burial : 1,000 ft.
Non-pipe construction costs are unknown

- a. Pipe Costs (Total Construction Cost) - From Table 4.2
 - 8" RCP, <8 ft. = \$18.57/ft.
 - 8" RCP, 8-15 ft. = \$23.84/ft.
 - 8" RCP, >15 ft. = \$35.49/ft.
- b. Total Kansas City, MO 1st Qtr 1979 Construction Cost
 $(\$18.57)(1,000) + (\$23.84)(2,000) + (\$35.49)(1,000) = \$101,740$
- c. Using Table 4.12 and Figure A.1, use Denver, CO CUSS Index = 159
1st Qtr 1980
Total Construction Cost = $\frac{(\$101,740)(159)}{170} = \$95,157$
- d. The above cost excludes Step 1 and Step 2 planning and engineering costs. Using the SMSA average from Table 4.10, these costs are 16.7 percent of the total construction cost.
Total Project Cost = $(\$95,157)(1.167) = \$110,048$

Example No. 3

A facility near Alliance, Ohio is planning an addition to their sewerage system. The following information is known about their needs and the probable materials to be utilized for construction:

8" Vitrified Clay Pipe, 8-15 ft. burial	: 6,200 ft.
12" Reinforced Concrete Pipe, 8-15 ft. burial	: 2,150 ft.
10" Cast Iron Pipe, 8-15 ft. burial	: 500 ft.
6" Force Main	: 850 ft.
48" Diameter Manhole, 8-15 ft. deep	: 20 each
Stream Crossing	: 1 (12" RCP sewer)
Rock Excavation	: None
Pump Station	: 1 @ 100 gpm <40 ft. discharge head

Using the data base presented in this report, there are a number of approaches possible to estimate this project. The one chosen uses the most basic data and builds upon it.

a. Bare-In-Place Gravity Sewer Costs

8" Vitrified Clay,	
8-15 ft. (Table F.8) = \$19.06/ft. x 6,200 ft. = \$118,172	
12" Reinforced Concrete Pipe,	
8-15 ft. (Table F.14) = \$30.22/ft. x 2,150 ft. = \$ 64,973	
10" Cast Iron Pipe,	
8-15 ft. (Table F.11) = \$24.29/ft. x 500 ft. = <u>\$ 12,145</u>	
Total Bare-In-Place Gravity Sewer Cost	= \$195,290

b. Force Main Bare-In-Place Costs - From Table 4.9

$$6" \text{ Force Main} = \$10.39/\text{ft.} \times 850 \text{ ft.} = \$8,832$$

c. Manhole Costs - From Table 4.7

$$48", \text{ non-SMSA, 8-15 ft.} = \$869.00/\text{ea.} \times 20 \text{ ea.} = \$17,380$$

d. Stream Crossings - From Table 4.6

$$4.0\% \text{ of total bare-in-place pipe costs} = (\$195,290)(0.04) = \$7,812$$

e. Other Non-Pipe Construction Costs for Gravity Sewers

Rock excavation, stream crossing, and manholes have been accounted for on an itemized basis above. Additional non-pipe construction costs are judged to be reasonable, and as shown below. These figures are percentages of bare-in-place pipe costs obtained from Table 4.6.

Appurtenances	:	1%
Rock Excavation	:	7%
Thoroughfare Crossings	:	4%
Pavement Replacement	:	6%
Utility Reconnection	:	1%
Mobilization	:	<u>6%</u>
Total		25%

Other Non-Pipe Construction Costs = $(\$195,290)(0.25) = \$48,822$

f. Construction Cost for Gravity Sewers

Bare-In-Place Pipe (a)	=	\$195,290
Manhole Costs (c)	=	17,380
Stream Crossings (d)	=	7,812
Other Non-Pipe Costs (e)	=	<u>48,822</u>

Gravity Sewer Construction Cost = \$269,304

Note: The non-pipe construction costs for this project are 37.9 percent of the bare-in-place pipe costs. This compares with the data base national average of 43.7 percent.

g. Force Main Construction Costs

Non-pipe construction costs associated with force main construction were found to be 25.7 percent of the bare-in-place costs (Table 4.9).

Force Main Construction = $(\$8,832)(1.257) = \$11,102$

h. Pump Station Costs - From Figure 4.4

Using Equation "A": Cost = $1.59 \times 10^3 q^{0.59} = \$24,066$

Other construction costs associated with pump stations are five percent of the above figure.

Pump Station Construction Cost = $(\$24,066)(1.05) = \$25,269$

i. Total Construction Costs

As defined herein, total construction costs include all construction costs plus Step 3 nonconstruction costs. The above calculations do not include the Step 3 costs.

Construction Costs:	Gravity Sewer	=	\$269,304
	Force Main	=	11,102
	Pump Station	=	<u>25,269</u>
	Total	=	\$305,675

From the discussion of Table 4.11, the national average Step 3 nonconstruction costs are 17.4 percent of the construction costs.

$$\text{Total Construction Costs} = (\$305,675)(1.174) = \$358,862$$

j. Total Project Cost

The total project cost is the total construction cost plus the Step 1 and Step 2 planning and engineering costs. From Figure 4.10, these costs are 3.82 and 13.84 percent for Step 1 and Step 2, respectively.

$$\text{Total Project Cost} = (\$358,862)(1.1766) = \$422,237$$

k. Compute Alliance, Ohio 1st Qtr 1980 costs - From Table 4.12 and Figure A.1.

From Figure A.1, use Cleveland, OH (City Code 107)
From Table 4.12, Cleveland, OH CUSS Index = 205

$$\text{Alliance, OH Cost} = \frac{(\$422,237)(205)}{170} = \$509,168$$

Example No. 3 is illustrative of the detail and judgment which can be used for estimation purposes. If more information is available, more refined estimates may be provided using the information from the tables in the Appendices.

Also, if type of pipe, depth of burial, types of non-pipe construction items, and nonconstruction items are known, more definitive estimates may be made. Conversely, if none of these factors are known, strict national averages may be applied (using Table 4.1 for gravity sewers). Such estimates will normally be accurate within 20 percent.

Simplified estimation techniques have been developed for other EPA projects. They are presented in Appendix B. These should be considered "rule of thumb" methods.

APPENDIX A

COST UPDATING AND NORMALIZATION TECHNIQUES

The data base utilized for this report includes costs from wastewater collection system projects in 47 of the contiguous States for the period 1973 to 1978. In order to achieve a meaningful analysis of the data, it was necessary to normalize all dollar values to a specific time and location.

To accomplish this, the EPA Complete Urban Sewer System Index (CUSS) was used. This Index has been calculated quarterly by EPA since the third quarter of 1973 for 25 U.S. cities (see Table 4.12). The CUSS Index is based on a hypothetical sewage system project in Kansas City, Missouri which includes the following components: a gravity collection system consisting of 16,700 feet of gravity sewer; 3,400 feet of force main; and a 550 gpm pumping station plus an interceptor consisting of 9,600 feet of 30 inch diameter pipe.

AREAS OF INFLUENCE

EPA publishes the CUSS Index as an indicator of the cost trends over time and as a basis of comparison for one city to another. The specific areas of cost influence relating to each of the 25 Index cities are not defined. Therefore, prior to using the Index for updating the costs acquired for this work, the area of influence for each of the Index cities was assessed and mapped. Two sources of information were employed in this effort - Bureau of Labor Statistics (BLS) Union Wages and Hours: Building Trades 1973-1978 for selected U.S. cities, and the Bureau of Economic Analysis (BEA) map of U.S. economic areas.

The BLS data consist of union labor rates for various building trades recorded annually for 65 to 70 U.S. cities. Some cities have been added and others have been dropped between 1973 and 1979 resulting in a total of 87 cities for which at least three years of data were available. In order to utilize this information, a weighted average of four building trades - carpenter, cement finisher, equipment operator, and laborer - were calculated for the six

calendar years from 1973 to 1978. Data from each city were compared with data from all the other 86 cities. Since all the EPA CUSS Index cities are included in the list of BLS cities, this process permitted the BLS cities to be related to the CUSS Index cities, thus defining the general area of influence for each of the CUSS Index cities.

The BEA economic areas were used to set the boundaries of economic influence surrounding each EPA Index city. A BEA economic area was composed of a central city and surrounding counties that are economically related to the central city as determined by BEA. Each of these areas includes both the place of work and place of residence of the labor force. The resulting map of the CUSS Index city areas of influence is presented in Figure A.1.

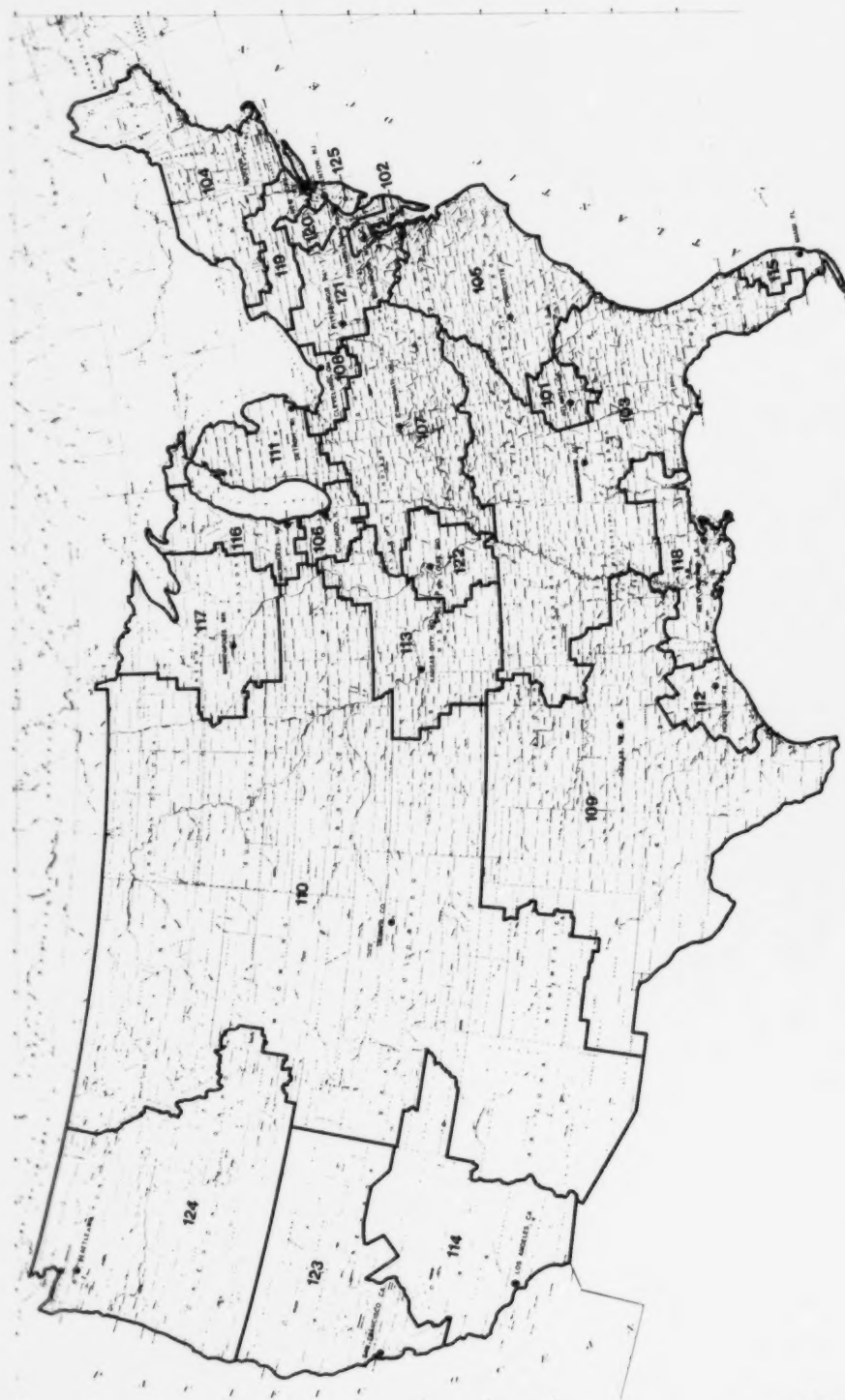
COST UPDATING

In order to update all costs to Kansas City, Missouri as of the first quarter of 1979, all projects were related to a specific CUSS Index city using the map in Figure A.1. Using the index values contained in Table 4.12, the costs were then normalized according to the following procedure:

$$\text{Construction Cost at (City x, Time t)} \times \frac{\text{Kansas City, MO 1st Qtr 1979 Index}}{\text{(City x, Time t) Index}} = \frac{\text{Construction Cost at Kansas City, MO 1st Qtr 1979}}{\text{Index}}$$

The data base was thus normalized to the base city of the CUSS Index. The effects on the results of the analyses of a large or small quantity of data from different areas of the U.S. or from a particular time period were thus minimized.

EPA CUSS INDEX MAP WITH AREAS OF INFLUENCE



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FIGURE A.1

APPENDIX B

SIMPLIFIED COLLECTION SYSTEM COST ESTIMATING TECHNIQUES

This Appendix presents simplified techniques for the estimation of the project costs for the construction of new sanitary sewers and pumping stations. These procedures are intended for the use of State and municipal officials, as well as laymen, in determining the approximate capital costs for wastewater collection systems.

These cost estimating procedures were developed for EPA for use in the 1980 Needs Survey. Needs Surveys are conducted biennially by the Agency in order to assess the cost of providing sewage collection and treatment as required by Public Law 95-217, and to report the results to Congress. Previous Needs Surveys were conducted in 1973, 1974, 1976, and 1978.

COST ESTIMATING TECHNIQUES

The essential elements for estimating the cost of a sewerage system are as follows:

1. The length of the sewers.
2. The diameter of the sewers.
3. The unit cost or cost per foot of the sewers.
4. The number and capacity of required pump stations.

Methods for estimating the above data are presented below along with examples of the use of estimating techniques.

Length

The length of the sewers may be determined by direct measurement on a map or from other information on actual distances to be traversed. In the absence of other information, EPA suggests the following per capita lengths be utilized as estimates:

Collector Sewers : 16 feet/capita
Interceptor Sewers : 1 feet/capita

Diameter

The diameter of the sewer is dependent upon the flow required to be transported. Generally, collector sewers may be assumed to be 8 inches in diameter. Interceptor sewer diameter may be estimated from Table B.1 which presents the required approximate diameters for a range of wastewater flows. In the absence of better information, a domestic and commercial wastewater flow of 100 gallons per capita may be assumed. Known industrial flows should be added, if present.

Unit Cost

Unit costs for sewer systems are dependent upon a number of factors including the diameter of the sewer, burial depth, type of pipe, geographical area, and the degree of urbanization.

Table B.2 presents the cost per foot of installed sanitary sewer for pipe diameters from 8 to 72 inches. The costs include all appurtenance costs and non-pipe construction costs and also include an allowance for Step 3 nonconstruction costs and Step 1 and Step 2 costs.

The cost data include pipe of all types and all depths from the wastewater collection system projects in the data base. This is considered adequate for preliminary estimates since specific information concerning the type of pipe required and the depth would normally not be available at this stage in planning.

The costs shown in Table B.2 have been normalized to first quarter 1979 dollars in Kansas City, Missouri using the cost indexing procedure described in Appendix A. In order to adjust the unit costs for other geographical areas of the U.S., the multipliers in Table B.3 must be utilized. Multipliers are provided for each of the 25 cities accounted for in the EPA CUSS Index. The map in Appendix A (Figure A.1) illustrates the area of influence for each of the CUSS Index cities.

TABLE B.1

SANITARY SEWER SIZING OF COLLECTOR
AND INTERCEPTOR SEWERS

<u>Pipe Diameter (Inches)</u>	<u>Average Flow Range (mgd)</u>
08	0.2 or Less
10	0.21 - 0.3
12	0.31 - 0.5
15	0.51 - 0.7
18	0.71 - 1.1
21	1.11 - 1.5
24	1.51 - 2.1
27	2.11 - 2.8
30	2.81 - 3.5
36	3.51 - 5.5
42	5.51 - 7.7
48	7.71 - 10.1
54	10.11 - 12.9
60	12.91 - 17.2
66	17.21 - 20.6
72	20.61 - 26.4

TABLE B.2
SANITARY SEWER TOTAL IN PLACE COSTS*
PER LINEAR FOOT

<u>Pipe Diameter (Inches)</u>	<u>Average Cost (\$/Foot)</u>
08	35
10	44
12	51
15	64
18	83
21	99
24	112
27	129
30	139
36	168
42	227
48	270
54	315
60	398
66	418
72	522

* Includes associated appurtenance and nonconstruction costs.

Note: All costs normalized to Kansas City, MO 1st Qtr 1979

TABLE B.3

SANITARY SEWER CONSTRUCTION AREA MULTIPLIERS

<u>Area Code</u>	<u>Area</u>	<u>Multiplier</u>
101	Atlanta, Georgia	0.77
102	Baltimore, Maryland	0.96
103	Birmingham, Alabama	0.75
104	Boston, Massachusetts	1.08
105	Charlotte, North Carolina	0.55
106	Chicago, Illinois	1.12
107	Cincinnati, Ohio	1.09
108	Cleveland, Ohio	1.11
109	Dallas, Texas	0.70
110	Denver, Colorado	0.79
111	Detroit, Michigan	1.10
112	Houston, Texas	0.80
113	Kansas City, Missouri	1.00
114	Los Angeles, California	1.14
115	Miami, Florida	0.83
116	Milwaukee, Wisconsin	1.00
117	Minneapolis, Minnesota	0.94
118	New Orleans, Louisiana	0.97
119	New York, New York	1.28
120	Philadelphia, Pennsylvania	1.17
121	Pittsburgh, Pennsylvania	1.08
122	St. Louis, Missouri	1.18
123	San Francisco, California	1.08
124	Seattle, Washington	1.12
125	Trenton, New Jersey	1.08

State and Territorial Multipliers:

Alaska	2.74
Guam	1.40
Hawaii	1.71
Puerto Rico	0.98
Trust Territories	1.40

In order to account for the degree of urbanization, an additional set of multipliers has been devised. These multipliers are presented in Table B.4. They should be applied on a county-wide basis according to the degree of urbanization as defined in the table. The multipliers were developed using the wastewater collection system cost data base and the Calvin Beale Metro/Adjacency Coding System developed by the U.S. Department of Agriculture.

Depending upon such factors as terrain, length of the collection system, and flow, pump stations can be a significant portion of the total system cost. If the number and design capacity of proposed pump stations are known, the costs can be derived from Figure 4.4. In most cases, however, this information will not be known because sufficient planning will not have been completed.

In such cases, EPA recommends that a rule of thumb of one pump station of 1.2 mgd capacity for each 65,000 feet of sewer be used. The pump station is estimated to cost \$185,000. No pump station cost should be included when the estimated collection system length is less than 39,000 feet. Otherwise, a ratio of the estimated sewer length to the unit length of 65,000 feet may be used. Thus, the cost may be estimated as follows:

$$\frac{\text{Projected Total Sewer Length}}{65,000 \text{ Feet}} \times \$185,000/\text{Pump Station} = \text{Cost of Pump Stations}$$

COST ESTIMATING EXAMPLES

The following examples are presented to illustrate the use of the cost estimating procedures presented in this Appendix. These procedures should be used when no additional source of planning information is available. The costs represent the entire grant eligible portion of the project, including the Step 1 and Step 2 portions, and the Step 3 construction phase.

Example No. 1

Estimate the total project cost to construct 5,000 ft. of 30 inch sewer in Louisville, Kentucky.

- a. From Table B.2, cost for 30" sewer = \$139/ft.
- b. From Table B.3 and Figure A.1, use Cincinnati, OH CUSS Index = 1.09

TABLE B.4
SANITARY SEWER CULTURAL MULTIPLIERS

<u>Cultural Definition</u>	<u>Multiplier</u>
<u>Urban:</u> Counties with metropolitan areas of 50,000 or more population	1.15
<u>Suburban:</u> Counties contiguous to an SMSA and having 2,500 or more urban residents. Also counties not contiguous to an SMSA having 20,000 or more urban residents	0.90
<u>Rural:</u> Counties less urbanized than the above	0.75

- c. From Table B.4, use the Urban Area Multiplier = 1.15
- d. Total Project Cost = $(\$139)(5,000 \text{ ft.})(1.09)(1.15) = \$871,000$

Note: This cost provides an allowance for Step 3 nonconstruction costs and non-pipe construction costs. Step 1 and Step 2 costs are also included.

Example No. 2

Estimate the total project cost for a wastewater collection system to serve a population of 2,500 persons in Mankato, Minnesota.

a. Collectors

Using a rule of thumb of 16 ft./capita for 8" collector sewers and costs from Table B.2, collector costs are estimated as follows:

$$2,500 \times 16 \text{ ft./capita} \times \$35/\text{ft.} = \$1,400,000$$

b. Interceptors

Since no flow information is presented, a per capita flow of 100 gallons may be assumed. From Table B.1, it is determined that a 10" interceptor would be necessary to transport the resulting 250,000 gpd total flow. The cost may be determined allowing one linear foot of interceptor/capita and using the unit costs from Table B.2.

$$2,500 \times \$44/\text{ft.} = \$110,000$$

c. Pump Station

The total sewer length is 42,500 ft., thus a pump station should be estimated as follows:

$$42,500 \text{ ft.}/65,000 \text{ ft.} \times \$185,000 = \$121,000$$

d. Total Project Cost

Collectors	=	\$1,400,000
Interceptors	=	110,000
Pump Station	=	<u>121,000</u>

$$\text{Total Project Cost} = \$1,631,000 \text{ (Kansas City, MO 1st Qtr 1979)}$$

e. Mankato, MN Cost - From Table B.3 and Figure A.1

From Figure A.1, use Minneapolis, MN (City Code 117) = 0.94
 From Table B.3, use Suburban Multiplier = 0.90

$$\text{Total Project Cost} = (\$1,631,000)(0.94)(0.90) = \$1,380,000$$

APPENDIX C

TOTAL CONSTRUCTION COST PER FOOT OF PIPE ALL PROJECTS, SMSA, NON-SMSA

Explanatory Notes

Tables C.1, C.2, and C.3 summarize gravity sewer construction cost data for all projects in the data base. Each table presents the bare-in-place costs, the non-pipe construction costs, the Step 3 nonconstruction costs, the total footage, the sample size, and the total construction cost for each diameter of pipe. Table C.1 is for all projects, while Tables C.2 and C.3 are separated into those projects within an SMSA and those outside an SMSA, respectively.

A comparison for equivalent sewers in various sections of the country may be determined by using the normalized figures from Tables C.1, C.2, or C.3 and the appropriate Index city figures found in Figure A.1 and Table 4.12. As an example, to compare the total construction costs per foot of pipe in second quarter 1980 dollars, for 8 inch pipe between Atlanta and New York City, the following calculation is performed using Table C.2 (both projects in an SMSA):

$$\text{Atlanta, GA (Area 101)} = \frac{(\$44.16)(147)}{170} = \$38.18/\text{ft.}$$

$$\text{New York, NY (Area 119)} = \frac{(\$44.16)(229)}{170} = \$59.49/\text{ft.}$$

Another example is appropriate. The same cost comparison as above is made, but the projects are not in the SMSA. Table C.3 is used in this example.

$$\text{Atlanta, GA (Area 101)} = \frac{(\$30.81)(147)}{170} = \$26.64/\text{ft.}$$

$$\text{New York, NY (Area 119)} = \frac{(\$30.81)(229)}{170} = \$41.50/\text{ft.}$$

TABLE C.1 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE FOR ALL PROJECTS - SMSA AND NON-SMSA
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE SIZE	TOTAL COST (\$/FT)
04	12.40	1.28	0.69	375923	116	14.37
06	12.45	4.95	2.20	1449790	378	19.60
08	22.34	10.47	4.11	11239460	2804	36.92
10	23.34	15.85	5.77	1710717	1499	44.95
12	27.31	17.51	6.84	1426912	1351	51.65
15	32.67	23.44	8.63	1041522	833	64.73
16	42.83	18.83	13.31	96417	220	74.97
18	38.50	42.25	26.17	1034552	979	106.92
21	43.84	22.04	10.36	542582	440	76.24
24	53.39	42.70	13.59	829947	825	109.67
27	57.20	35.39	18.94	285182	210	111.52
30	69.98	65.05	16.41	634664	563	151.44
36	89.87	95.07	19.44	556655	481	204.37
42	128.08	47.58	23.15	298731	230	198.81
48	119.75	59.14	31.20	262736	127	210.09
54	221.37	68.71	36.30	223042	173	326.38
60	212.96	90.60	44.55	174643	146	348.11
66	198.27	105.69	49.27	82682	46	353.23
72	245.43	111.54	58.68	93950	84	415.65
78	279.19	140.68	76.52	65710	41	496.38
84	333.00	88.59	59.74	41243	14	481.33
90	303.47	167.64	60.49	2999	4	531.59
96	361.63	54.99	49.64	58611	28	466.25
102	304.47	122.16	156.96	6970	1	583.58

TABLE C.2 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE FOR SMSA PROJECTS
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE TOTAL COST (\$/FT)
04	14.68	1.17	0.67	139375	35 16.51
06	13.99	5.86	2.47	495139	169 22.31
08	23.90	15.03	5.23	5209042	1311 44.16
10	23.99	23.68	7.02	865832	714 54.69
12	27.20	24.88	8.21	645967	656 60.28
15	30.09	33.61	9.48	498920	420 73.18
16	44.02	17.49	9.17	44556	121 70.68
18	40.27	61.99	39.68	492283	504 141.93
21	47.28	21.88	11.31	259054	201 80.46
24	47.34	54.44	14.00	381726	379 115.78
27	57.88	37.35	20.54	173274	134 115.76
30	67.64	77.47	17.18	440370	344 162.28
36	83.36	113.62	19.44	418581	316 216.42
42	92.93	48.22	23.63	237743	138 164.78
48	116.39	56.10	32.55	199591	92 205.04
54	229.57	68.44	37.73	192098	148 335.74
60	214.28	89.35	44.90	131733	96 348.52
66	196.68	106.52	49.71	82038	39 352.90
72	255.14	111.64	59.24	77134	65 426.02
78	279.19	140.68	76.52	65710	41 496.38
84	333.00	88.59	59.74	41243	14 481.33
90	303.47	167.64	60.49	2999	4 531.59
96	361.63	54.99	49.64	58611	28 466.25
102	304.47	122.16	156.96	6970	1 583.58

APPENDIX D

TOTAL CONSTRUCTION COST PER FOOT OF PIPE BY PIPE MATERIAL

Explanatory Notes

Tables D.1 through D.8 summarize gravity sewer pipe total construction costs for the various pipe materials (PVC, RCP, etc.) by diameter of the pipe. The tables reflect the unit, non-pipe, and Step 3 nonconstruction items for each pipe material. The national costs are also summarized in Table 4.1.

TABLE D.1 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE BY PIPE MATERIAL - PVC PIPE
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE SIZE	TOTAL COST (\$/FT)
04	13.46	1.24	0.67	52163	18	15.36
06	9.79	2.86	1.32	137261	43	13.96
08	21.81	12.34	4.14	1731755	392	38.29
10	23.76	14.82	5.87	268401	252	44.44
12	25.52	22.97	7.25	160836	169	55.73
15	30.18	13.38	6.45	85333	82	50.01
16	0.00	0.00	0.00	0	0	0.00
18	12.24	19.78	5.64	577	1	37.66
21	49.17	23.37	5.59	4436	3	78.12
24	44.72	30.52	7.30	3613	3	82.54

TABLE D.2 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE BY PIPE MATERIAL - ASBESTOS CEMENT PIPE
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE SIZE	TOTAL COST (\$/FT)
04	8.91	0.70	0.41	19965	6	10.01
06	12.86	3.99	1.94	91860	13	18.79
08	23.52	10.83	3.83	1582181	378	38.17
10	23.01	20.13	6.57	229529	229	49.70
12	27.59	26.72	6.34	182197	174	60.64
15	30.19	79.87	10.60	102039	88	120.65
16	45.70	23.20	19.87	27034	40	88.77
18	26.67	21.88	15.11	131882	132	63.65
21	37.54	38.05	22.60	39477	45	98.19
24	38.63	27.11	16.40	51556	50	82.13
27	25.34	5.97	3.17	7140	4	34.48
30	26.63	3.00	2.53	5360	3	32.16

TABLE D.3 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE BY PIPE MATERIAL - VITRIFIED CLAY PIPE
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE TOTAL COST (\$/FT)
04	10.22	1.30	0.85	142067	16 12.37
06	13.00	2.71	1.67	520638	119 17.37
08	19.90	5.90	3.44	3493995	784 29.24
10	20.97	8.43	4.32	452830	421 33.71
12	25.61	10.54	5.45	407880	420 41.59
15	30.05	14.51	8.48	348192	284 53.03
16	33.87	32.54	25.67	5584	14 92.08
18	36.55	20.93	10.56	255695	208 68.03
21	41.41	18.53	9.21	142073	104 69.14
24	51.57	25.50	11.59	159740	120 88.66
27	72.18	30.28	14.11	46856	22 116.56
30	71.63	45.48	18.36	67977	31 135.47
36	75.05	54.58	25.11	26038	18 154.74
42	64.53	9.17	5.78	5010	3 79.47
48	71.46	40.12	21.37	5321	4 132.95

TABLE D.4 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE BY PIPE MATERIAL - CAST IRON PIPE
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE SIZE	TOTAL COST (\$/FT)
04	9.04	0.87	0.25	1264	5	10.15
06	16.44	4.86	3.08	38328	15	24.38
08	27.41	31.17	7.96	33160	85	66.53
10	29.70	55.19	14.45	9404	52	99.34
12	39.28	11.50	7.08	6078	49	57.85
15	83.38	26.22	10.41	365	4	120.01
16	55.30	22.83	15.72	2535	18	93.84
18	53.13	19.14	16.84	6369	19	89.11
21	142.13	13.17	7.99	300	1	163.29
24	135.85	35.60	16.64	6150	28	188.08
27	0.00	0.00	0.00	0	0	0.00
30	62.87	41.66	10.43	357	2	114.96
36	75.22	20.71	13.70	372	1	109.62

TABLE D.5 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE BY PIPE MATERIAL - REINFORCED CONCRETE PIPE
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE SIZE	TOTAL COST (\$/FT)
04	10.50	0.67	0.69	774	4	11.86
06	10.48	1.51	1.56	223	4	13.54
08	15.78	4.14	1.52	93412	49	21.44
10	19.65	8.38	3.46	33844	23	31.49
12	20.51	32.75	9.28	72282	56	62.54
15	29.66	34.11	10.31	136278	149	74.08
16	54.61	9.76	5.45	4887	12	69.81
18	42.32	66.43	52.82	285449	299	161.57
21	48.99	24.29	10.46	206353	212	83.74
24	46.56	55.95	13.63	402128	400	116.13
27	55.43	41.12	20.98	148398	133	117.52
30	65.58	86.09	16.94	367536	357	168.60
36	85.80	120.92	19.19	399115	358	225.90
42	111.89	46.16	23.01	236292	187	181.06
48	114.07	62.18	33.39	186459	96	209.63
54	216.42	61.56	35.62	200222	152	313.59
60	198.31	104.54	46.62	133994	104	349.47
66	186.83	121.06	52.75	46112	39	360.64
72	248.10	112.84	55.53	88671	71	416.46
78	253.21	101.85	60.38	64463	36	415.44
84	352.74	128.13	79.04	11264	6	559.90
90	216.52	167.64	60.49	2909	3	444.64
96	239.46	70.36	59.95	17600	1	369.76
102	304.47	122.16	156.96	6970	1	583.58

TABLE D.6 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE BY PIPE MATERIAL - DUCTILE IRON PIPE
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE TOTAL COST (\$/FT)
04	16.05	1.23	0.83	9878	18.11
06	18.25	4.04	3.03	10712	25.32
08	28.21	9.78	4.18	100461	42.16
10	31.42	8.63	4.41	32301	44.46
12	35.83	17.03	8.60	23298	61.45
15	39.10	19.86	14.31	151	73.26
16	40.71	16.34	11.12	43458	68.17
18	49.91	23.06	9.84	39678	82.80
21	62.60	23.81	19.51	756	105.92
24	70.57	24.58	12.11	28911	107.26
27	0.00	0.00	0.00	0	0.00
30	100.34	52.94	20.09	23330	173.36
36	157.49	37.26	17.86	7721	212.61
42	434.50	76.53	39.49	3195	550.52

TABLE D.7 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE BY PIPE MATERIAL - ABS PIPE
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE SIZE	TOTAL COST (\$/FT)
04	11.79	3.36	2.11	3093	2	17.26
06	12.16	7.57	4.74	300	2	24.46
08	25.65	12.70	11.18	35901	17	49.53
10	17.97	13.96	8.35	10345	2	40.27
12	27.58	19.69	26.66	4350	5	73.92
15	33.17	47.29	29.64	1314	1	110.10
16	0.00	0.00	0.00	0	0	0.00
18	0.00	0.00	0.00	0	0	0.00
21	0.00	0.00	0.00	0	0	0.00
24	19.25	18.09	7.27	2789	1	44.60

TABLE D.8 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE BY PIPE MATERIAL - OTHER/UNKNOWN
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE TOTAL COST (\$/FT)
04	13.17	1.48	0.72	146719	15.36
06	11.59	7.05	2.48	650468	21.12
08	22.37	7.13	3.25	4168595	32.75
10	23.18	9.18	4.13	674063	36.49
12	27.18	10.47	5.00	559541	42.64
15	38.93	15.61	7.26	367850	61.79
16	37.89	19.35	10.69	12919	67.93
18	35.30	43.49	16.39	313568	95.17
21	33.33	18.65	8.41	149187	60.39
24	51.49	28.19	12.31	172420	92.39
27	57.85	30.45	18.54	82788	106.83
30	73.34	26.91	15.56	166278	115.81
36	91.94	36.64	18.66	122659	147.24
42	122.81	56.36	23.64	54234	202.81
48	147.09	55.71	29.76	70956	232.56
54	257.19	105.64	48.31	22820	411.14
60	249.25	63.72	48.35	40649	361.31
66	262.04	31.15	28.34	36570	321.52
72	230.83	87.11	55.93	5279	373.87
78	466.25	182.83	88.66	1247	737.73
84	318.19	36.07	31.29	29979	385.55
90	564.33	42.09	26.54	90	632.95
96	366.15	49.86	46.21	41011	462.21

APPENDIX E

TOTAL CONSTRUCTION COST PER FOOT OF PIPE BY DEPTH OF BURIAL

Explanatory Notes

Tables E.1 through E.3 are a subset of the complete data base (all pipe materials) separated into groups based upon depth of burial of the pipe. The tables reflect the unit, non-pipe, and Step 3 nonconstruction costs for each depth range. The national costs are also summarized in Table 4.1.

TABLE E.1 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - DEPTH LESS THAN 8 FEET
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE TOTAL COST (\$/FT)
04	11.86	1.08	0.64	490	2 13.58
06	11.28	1.86	2.15	82151	26 15.29
08	17.18	11.61	4.49	3221238	523 33.28
10	17.41	8.90	4.88	248470	224 31.18
12	22.27	10.91	6.40	193024	190 39.58
15	22.67	14.92	8.68	200393	127 46.27
16	39.94	13.80	8.12	19823	45 61.86
18	31.14	20.86	11.32	154224	150 63.31
21	35.51	23.20	11.44	71734	57 70.14
24	42.74	27.30	13.80	90193	95 83.83
27	74.11	43.10	19.22	13021	16 136.43
30	61.39	40.14	18.48	54720	61 120.01
36	91.55	43.23	19.36	8131	24 154.13
42	104.57	46.71	19.37	3759	11 170.64
48	84.78	48.38	26.85	2884	4 160.01
54	119.50	73.45	20.61	298	8 213.56
60	470.39	137.40	45.09	344	1 652.87

TABLE E.2 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - DEPTH 8-15 FEET
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE TOTAL COST (\$/FT)
04	11.17	0.67	0.69	302	12.53
06	12.98	2.97	2.04	201419	17.99
08	21.14	11.41	4.42	4224380	36.97
10	20.53	20.71	7.09	574037	48.33
12	23.15	14.67	7.57	418195	45.38
15	27.35	21.47	9.51	291101	58.33
16	38.75	15.20	11.57	33675	65.52
18	33.88	18.47	10.77	343861	63.11
21	49.57	27.03	12.84	149381	89.44
24	45.48	29.02	14.85	274017	89.34
27	49.42	34.38	15.96	62525	99.75
30	63.49	35.58	18.06	161013	117.13
36	78.68	43.82	21.29	147271	143.79
42	121.69	49.98	22.92	53541	194.58
48	88.25	65.13	30.25	41328	183.62
54	176.56	70.01	39.94	26976	286.51
60	221.12	95.93	66.38	19623	383.42
66	94.68	86.64	43.53	25	224.85
72	159.21	73.75	39.96	2066	272.91

TABLE E.3 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - DEPTH GREATER THAN 15 FEET
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE SIZE	TOTAL COST (\$/FT)
04	0.00	0.00	0.00	0	0	0.00
06	18.66	1.92	3.37	12634	10	23.94
08	33.89	7.87	3.82	551821	441	45.57
10	33.75	8.87	4.63	132716	251	47.25
12	38.50	11.55	5.89	122511	234	55.94
15	40.66	16.03	6.86	58203	130	63.55
16	50.33	15.05	13.55	14169	38	78.93
18	51.59	19.16	11.41	45773	176	82.15
21	47.53	26.20	12.45	37982	101	86.17
24	63.86	31.21	15.51	92107	200	110.57
27	61.23	32.68	13.82	30000	54	107.72
30	74.29	36.07	18.68	86723	170	129.03
36	99.71	42.68	21.53	90462	159	163.92
42	169.07	50.49	22.83	46101	77	242.39
48	129.51	78.45	38.34	28742	27	246.29
54	251.57	87.74	44.47	70575	89	383.77
60	226.85	85.56	71.70	42562	65	384.11
66	181.75	89.58	42.89	4079	10	314.22
72	199.38	73.75	39.96	23552	26	313.08
78	0.00	0.00	0.00	0	0	0.00
84	0.00	0.00	0.00	0	0	0.00
90	0.00	0.00	0.00	0	0	0.00
96	348.35	63.95	22.93	29302	25	435.23

APPENDIX F

TOTAL CONSTRUCTION COST PER FOOT OF PIPE BY PIPE MATERIAL AND DEPTH OF BURIAL

Explanatory Notes

Tables F.1 through F.24 provide a breakdown on the costs of gravity sewers based upon depth of burial and type of pipe material. These data are summarized in Table 4.2 of the report. Included in each table are unit costs, non-pipe, and Step 3 nonconstruction costs for each pipe diameter.

TABLE F.1 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - PVC PIPE - DEPTH LESS THAN 8 FEET
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE TOTAL COST SIZE (\$/FT)
06	9.77	1.61	0.58	5526	5 11.95
08	16.66	6.13	2.85	732621	86 25.64
10	16.03	7.51	4.34	72958	46 27.87
12	17.51	9.72	4.79	40934	27 32.01
15	21.83	17.28	8.67	19170	14 47.78

TABLE F.2 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - PVC PIPE - DEPTH 8-15 FEET
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE SIZE	TOTAL COST (\$/FT)
06	9.60	2.56	0.97	18144	13	13.13
08	14.95	12.01	4.22	613750	191	36.18
10	19.97	14.48	6.97	103709	122	46.42
12	20.60	9.44	5.14	62921	80	35.17
15	25.28	16.11	8.17	27601	44	49.55
21	37.63	23.37	5.59	3377	2	66.58
24	44.72	30.52	7.30	3613	3	82.54

TABLE F.3 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - PVC PIPE - DEPTH GREATER THAN 15 FEET
(Step 1 and Step 2 costs excluded.)

OIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 WCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE SIZE	TOTAL COST (\$/FT)
06	11.63	2.80	1.09	264	1	15.51
08	37.28	15.17	5.43	52246	71	57.89
10	40.25	7.46	3.44	26573	63	51.14
12	43.68	9.24	4.40	14144	41	57.31
15	54.43	14.67	7.11	4730	17	76.20
21	72.24	23.37	5.59	1059	1	101.19

TABLE F.4 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - ASBESTOS CEMENT PIPE - DEPTH LESS THAN 8 FEET
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE SIZE	TOTAL COST (\$/FT)
08	18.69	6.67	4.06	286959	67	29.42
10	20.33	10.14	6.44	33501	31	36.90
12	26.20	12.43	6.93	28354	23	45.56
15	18.64	14.61	8.85	32005	12	42.10
16	48.55	23.38	10.75	3994	5	82.67
18	24.57	18.78	10.98	17442	23	54.32
21	24.80	22.17	15.06	9926	7	62.62
24	30.24	42.84	31.19	2117	4	104.27

TABLE F.5 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - ASBESTOS CEMENT PIPE - DEPTH 8-15 FEET
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE TOTAL COST (\$/FT)
06	13.39	6.17	1.51	6654	21.07
08	21.52	6.71	3.87	1016958	32.09
10	19.13	11.13	6.35	119075	36.61
12	21.64	14.32	8.18	77895	44.14
15	22.69	15.54	8.78	40181	47.00
16	39.02	15.19	15.29	16084	69.49
18	26.13	17.63	14.54	71847	58.30
21	35.41	51.60	29.86	20552	116.86
24	28.40	24.49	21.13	28032	74.02

TABLE F.6 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - ASBESTOS CEMENT PIPE - DEPTH GREATER THAN 15 FEET
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE SIZE	TOTAL COST (\$/FT)
-----	-----	-----	-----	-----	-----	-----
08	33.14	6.50	3.81	73166	74	43.45
10	29.98	10.44	6.19	27763	50	46.61
12	36.61	16.37	9.90	28199	35	62.88
15	40.71	20.84	10.12	11465	25	71.67
16	49.14	18.41	18.00	5135	10	85.54
18	32.29	14.44	18.56	7638	26	65.28
21	52.71	25.89	19.12	1314	14	97.72
24	66.34	34.96	25.96	11665	13	127.26

TABLE F.7 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - VITRIFIED CLAY PIPE - DEPTH LESS THAN 8 FEET
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE SIZE	TOTAL COST (\$/FT)
06	10.90	2.14	4.32	38139	11	17.35
08	15.96	5.49	2.97	712201	120	24.41
10	15.91	8.37	4.39	56693	59	28.67
12	19.96	10.50	5.62	46502	53	36.08
15	23.97	14.78	9.69	89358	53	48.44
16	24.33	9.87	22.76	1461	1	56.95
18	29.85	21.13	11.09	48374	27	62.06
21	33.70	20.57	8.69	14745	14	62.95
24	40.90	22.21	9.41	20405	11	72.52
27	42.73	28.40	15.77	1994	1	86.90
30	51.80	36.50	18.74	4620	4	107.04

TABLE F.8 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - VITRIFIED CLAY PIPE - DEPTH 8-15 FEET
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE TOTAL COST (\$/FT)
06	13.17	3.63	3.64	35380	27 20.44
08	19.06	5.55	3.29	1452666	354 27.90
10	19.79	8.89	4.62	180841	210 33.30
12	23.21	10.82	6.55	145821	192 40.58
15	28.66	14.39	8.47	110156	134 51.52
16	28.29	32.54	25.67	3791	8 86.50
18	34.03	19.08	10.28	72460	98 63.38
21	38.39	22.83	10.70	35217	38 71.92
24	48.68	26.06	12.72	35264	51 87.46
27	46.49	28.40	15.77	11137	4 90.66
30	46.08	30.26	15.42	5351	7 91.76
36	34.82	25.61	12.64	329	1 73.06

TABLE F.9 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - VITRIFIED CLAY PIPE - DEPTH GREATER THAN 15 FEET
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE SIZE	TOTAL COST (\$/FT)
06	28.19	1.23	8.13	67	3	37.55
08	26.47	6.12	2.94	114623	144	35.53
10	30.07	8.66	4.15	30616	59	42.88
12	37.37	11.82	5.79	38636	72	54.98
15	40.56	19.99	8.94	9741	30	69.49
16	44.72	9.87	22.76	332	5	77.34
18	44.25	25.73	10.71	10642	31	80.68
21	58.31	30.22	12.81	13897	25	101.33
24	63.43	28.08	13.45	7261	27	104.95
27	54.01	28.40	15.77	3601	6	98.18
30	34.94	17.78	8.78	3489	4	61.50
36	48.04	25.61	12.64	4088	9	86.28

TABLE F.10 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - CAST IRON PIPE - DEPTH LESS THAN 8 FEET
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE SIZE	TOTAL COST (\$/FT)
06	20.52	2.46	0.97	25	1	23.94
08	26.95	141.60	30.02	4240	19	198.57
10	17.92	8.72	3.86	601	5	30.49
12	26.41	5.65	5.71	401	4	37.77
16	46.73	9.94	9.95	848	5	66.62
18	87.80	10.89	6.24	365	1	104.92
24	50.03	28.85	16.12	1074	2	94.99

TABLE F.11 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - CAST IRON PIPE - DEPTH 8-15 FEET
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 MCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE SIZE	TOTAL COST (\$/FT)
06	15.73	2.46	0.97	34	2	19.15
08	23.12	101.90	22.21	6533	28	147.22
10	24.29	172.54	37.89	3001	18	234.72
12	32.39	16.49	7.27	882	17	56.15
16	56.14	21.06	10.25	575	6	87.45
18	51.30	22.13	8.73	241	5	82.16
24	71.05	39.35	15.52	468	5	125.92

TABLE F.12 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - CAST IRON PIPE - DEPTH GREATER THAN 15 FEET
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE TOTAL COST (\$/FT)
08	24.25	13.30	4.79	169	42.34
10	31.16	11.43	6.41	795	49.00
12	35.65	21.81	9.73	55	67.19
18	39.10	67.33	24.27	290	130.69

TABLE F.13

TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - REINFORCED CONCRETE PIPE - DEPTH LESS THAN 8 FEET
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE TOTAL COST (\$/FT)
04	8.51	0.67	0.69	472	1 9.87
06	8.51	1.51	1.56	136	1 11.57
08	10.32	5.28	1.97	8309	11 18.57
10	24.37	17.04	7.48	5840	3 48.89
12	12.28	17.60	3.65	4341	7 33.53
15	25.41	20.42	8.55	29125	21 54.37
16	50.20	11.85	7.52	1272	2 69.56
18	30.79	26.89	12.87	38540	41 70.55
21	34.31	26.76	12.41	40203	28 73.47
24	40.72	31.01	14.90	42475	42 86.63
27	47.00	49.65	22.35	10451	12 119.00
30	53.70	41.94	19.43	28619	29 115.06
36	71.51	42.70	19.32	3865	17 133.52
42	68.15	41.21	15.23	3729	10 124.59
48	81.78	61.28	35.20	1060	3 178.26
54	119.50	73.45	20.61	298	8 213.56
60	470.39	137.40	45.09	344	1 652.87

TABLE F.14 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - REINFORCED CONCRETE PIPE - DEPTH 8-15 FEET
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 MCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE SIZE	TOTAL COST (\$/FT)
04	11.17	0.67	0.69	302	3	12.53
06	11.14	1.51	1.56	87	3	14.20
08	14.13	7.40	2.32	5599	15	23.84
10	28.49	17.04	7.48	3755	8	53.01
12	30.22	45.55	23.26	3852	14	139.03
15	29.74	50.43	15.53	43363	57	95.69
16	52.87	9.92	6.27	2100	3	69.05
18	35.81	22.66	10.95	117803	136	69.42
21	62.34	26.78	11.32	56608	91	100.43
24	40.39	32.77	14.60	151521	155	87.75
27	54.03	38.30	17.74	31016	36	110.07
30	53.92	38.62	18.54	103455	130	111.07
36	71.82	43.75	21.75	130987	122	137.31
42	101.14	39.23	22.93	48825	51	163.34
48	87.68	68.12	34.82	25175	15	190.62
54	155.97	70.01	39.94	26322	38	265.92
60	195.42	95.93	66.38	18914	25	357.72
66	94.68	86.64	43.53	25	1	224.85
72	153.98	85.23	48.51	1956	5	287.72

TABLE F.15 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - REINFORCED CONCRETE PIPE - DEPTH GREATER THAN 15 FEET
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE SIZE	TOTAL COST (\$/FT)
08	26.58	07.35	1.56	1102	6	35.49
12	27.66	5.66	1.84	658	3	35.15
15	39.65	12.75	4.32	16383	34	56.72
16	50.41	11.85	7.52	1310	6	69.77
18	54.51	16.10	8.55	17031	64	79.15
21	42.46	25.45	11.60	18892	54	79.50
24	52.46	33.06	14.52	52515	119	100.04
27	66.95	35.43	14.24	17960	39	116.68
30	74.95	37.94	19.44	75069	135	132.33
36	103.01	42.90	22.57	77889	131	168.48
42	146.82	44.74	22.62	42464	67	214.18
48	129.51	78.45	38.34	28742	27	246.29
54	244.70	73.26	44.17	69441	79	362.12
60	196.07	85.56	71.70	38821	49	353.33
66	181.75	89.58	42.89	4079	10	314.22
72	199.82	85.23	48.51	23280	22	333.56

TABLE F.16 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - DUCTILE IRON PIPE - DEPTH LESS THAN 8 FEET
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE SIZE	TOTAL COST (\$/FT)
04	15.22	1.49	0.59	18	1	17.30
06	20.79	2.53	0.93	371	3	24.25
08	21.90	4.75	3.72	36779	76	30.36
10	23.91	6.22	3.24	5284	20	33.37
12	37.61	7.15	3.09	2620	19	47.84
15	28.50	16.68	11.14	10	1	56.31
16	38.32	13.80	7.28	8758	27	59.39
18	43.54	23.31	10.28	9945	26	77.12
21	39.38	32.90	25.93	170	2	98.21
24	54.32	30.84	15.05	9535	23	100.20
30	86.93	48.47	22.33	9979	12	157.73
36	148.66	51.06	15.95	362	4	215.66
42	468.80	68.69	35.92	30	1	573.41

TABLE F.17 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - DUCTILE IRON PIPE - DEPTH 8-15 FEET
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE SIZE	TOTAL COST (\$/FT)
06	21.48	3.38	0.92	120	3	25.78
08	28.24	6.35	4.37	14997	96	38.95
10	29.40	8.76	4.19	1353	29	42.35
12	32.63	8.90	3.10	2510	20	44.63
15	39.03	10.96	10.05	65	4	60.03
16	39.26	13.07	9.46	7357	36	61.78
18	43.86	24.17	11.00	6187	32	79.02
24	74.31	33.06	14.37	3194	34	121.74
30	116.63	47.91	22.68	4471	18	187.22
36	197.83	42.91	15.26	2574	10	256.00
42	481.04	68.69	35.92	1170	4	585.65

TABLE F.18 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - DUCTILE IRON PIPE - DEPTH GREATER THAN 15 FEET
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE SIZE	TOTAL COST (\$/FT)
08	52.11	5.45	3.75	846	10	61.30
10	34.65	5.79	4.35	1380	4	44.78
12	42.99	12.73	3.05	805	9	58.76
16	53.85	14.55	9.80	7286	16	78.19
18	69.53	30.06	15.36	4497	24	114.94
24	97.26	28.64	11.34	6854	19	137.23
30	94.65	52.60	21.09	681	10	168.34
36	148.07	36.73	15.61	330	4	200.41
42	511.32	68.69	35.92	335	4	615.93

TABLE F.19 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - ABS PIPE - DEPTH LESS THAN 8 FEET
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE SIZE	TOTAL COST (\$/FT)
08	25.35	19.14	30.67	6910	2	75.15
12	32.49	43.06	69.00	120	1	144.55
24	19.25	18.09	7.27	2789	1	44.60

TABLE F.20 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - ABS PIPE - DEPTH 8-15 FEET
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE SIZE	TOTAL COST (\$/FT)
08	26.95	16.47	17.02	10610	9	60.43
12	37.78	43.06	69.00	490	2	149.84

TABLE F.21 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - ABS PIPE - DEPTH GREATER THAN 15 FEET
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE TOTAL COST SIZE (\$/FT)
08	38.87	16.47	17.02	105	2 72.35

TABLE F.22 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - OTHER/UNKNOWN - DEPTH LESS THAN 8 FEET
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE SIZE	TOTAL COST (\$/FT)
06	6.63	1.36	0.59	37954	5	8.58
08	14.41	5.03	3.20	1433214	142	23.24
10	15.87	9.10	4.67	73593	60	29.63
12	20.05	8.93	5.10	59302	53	34.08
15	19.92	13.55	7.87	30725	26	41.33
16	32.38	6.61	7.45	3490	5	46.44
18	24.65	17.32	11.30	38399	28	53.26
21	56.57	15.79	10.26	6690	6	82.61
24	29.94	23.32	13.86	9158	8	67.11
27	193.01	19.15	6.92	576	3	219.08
30	65.57	31.61	17.20	8076	9	114.38
36	128.97	37.71	14.90	3904	3	181.57
48	93.79	22.57	10.15	1824	1	126.51

TABLE F.23 TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - OTHER/UNKNOWN - DEPTH 8-15 FEET
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE TOTAL COST (\$/FT)
06	13.87	2.05	0.85	141000	13 16.76
08	21.72	6.13	2.81	1103267	353 30.65
10	20.54	9.86	4.31	162303	169 34.70
12	22.10	11.42	5.57	123824	141 39.08
15	26.38	14.98	7.28	69735	79 48.63
16	29.04	5.72	7.41	3768	9 42.16
18	31.96	17.41	9.11	75323	74 58.48
21	30.23	26.52	12.38	33627	23 69.12
24	44.99	23.86	14.88	51925	41 83.72
27	40.86	23.56	10.65	20372	18 75.07
30	76.01	25.15	17.99	47336	35 119.15
36	66.16	42.13	20.67	12631	22 128.96
42	72.74	73.61	22.89	3546	8 169.24
48	89.93	57.63	18.81	16153	5 166.37
54	307.00	81.75	79.85	654	6 468.60
60	301.43	97.08	107.96	709	8 506.47
72	185.36	50.78	22.84	110	1 258.98

TABLE F.24

TOTAL CONSTRUCTION COSTS PER FOOT OF PIPE - OTHER/UNKNOWN - DEPTH GREATER THAN 15 FEET
(Step 1 and Step 2 costs excluded.)

DIA (IN)	UNIT COST (\$/FT)	NON-PIPE (\$/FT)	STEP 3 NCC (\$/FT)	SAMPLE FOOTAGE	SAMPLE SIZE	TOTAL COST (\$/FT)
06	15.07	2.08	0.96	12303	6	18.10
08	39.49	6.29	3.24	109564	133	49.01
10	33.86	9.05	4.65	45589	69	47.55
12	37.59	10.36	5.37	40014	71	53.32
15	32.40	13.42	5.53	15884	24	51.35
16	33.39	6.62	11.61	106	1	51.61
18	55.74	15.19	8.99	5675	30	79.91
21	34.19	22.11	11.88	2420	7	68.17
24	95.69	28.94	17.69	13807	22	142.31
27	41.27	27.36	12.50	8439	9	81.12
30	67.86	22.06	17.00	7484	21	106.92
36	88.96	42.97	21.27	8155	15	153.20
42	189.30	79.25	23.85	3302	6	292.40
54	305.88	128.17	63.08	1134	10	497.12
60	321.11	97.08	107.96	3741	16	526.15
72	197.01	50.78	22.84	272	4	270.63
96	348.35	63.95	22.93	29302	25	435.23

APPENDIX G

PROJECT LIST USED FOR DATA BASE

Explanatory Notes

Table G.1 lists the projects which make up the data base reported upon in this report. The projects are sorted alphabetically by State, and numerically by ascending grant number within each State. Many projects had multiple grants. The number shown is for the last grant associated with the project.

In addition, the name of the facility, and the city and county in which it is located, are identified.

TABLE G.1

SEWER CONSTRUCTION PROJECTS IN THE DATA BASE - LISTED BY STATE

GRANT NO	FACILITY NAME	CITY	STATE	COUNTY
010250	MONROEVILLE	MONROEVILLE	ALA	MONROE
010254	RUSSELLVILLE SEWER SYSTEM	RUSSELLVILLE	ALA	FRANKLIN
010256	DEW HOPE	DEW HOPE	ALA	MAULSON
010281	THEVIER SEWER SYSTEM	THEVIER	ALA	MOBILE
010290	TUSCALOOSA INTERCEPTORS	TUSCALOOSA	ALA	TUSCALOOSA
010296	TOWN CREEK SEWER SYSTEM	TOWN CREEK	ALA	LAWRENCE
010300	DOCTORS BRANCH IS	JASPER	ALA	WALKER
010305	FUTAW COLL SYS	FUTAW	ALA	GREENE
010313	GROVE HILL SEWER SYSTEM	GROVE HILL	ALA	CLAY
010318	DEMOPOLIS SEWERS	DEMOPOLIS	ALA	MAHONGO
040125	SUPERIOR COLL SYSTEM	SUPERIOR	ARIZ	PINAL
040145	SHOW LOW SS	SHOW LOW	ARIZ	NAVAJO
040147	S MILLITO INTERCEPTOR	TUCSON	ARIZ	PIMA
040147	PILLITO INTERCEPTOR	TUCSON	ARIZ	PIMA
040148	FLAGSTAFF WEMAR	FLAGSTAFF	ARIZ	COCONINO
040160	SOUTHWEST INTERCEPTOR	TUCSON	ARIZ	PIMA
040162	WINDY ROCK-FT. DEFJACE	FT. DEFJACE	ARIZ	APACHE
040179	HOLBROOK INTERCEPTORS	HOLBROOK	ARIZ	NAVAJO
040183	JOSEPH CITY SS	JOSEPH CITY	ARIZ	NAVAJO
040193	GLENDAL	GLENDAL	ARIZ	MARICOPA
040196	ARIZONA CITY SS	ARIZONA CITY	ARIZ	PINAL
040214	SOMERSON SS	SOMERSON	ARIZ	YUMA
040219	DOUGLAS SS	DOUGLAS	ARIZ	COCHISE
040220	COLUMBIA CITY/HILDAL	HILDAL	ARIZ	WASHINGTON
050332	RATESVILLE SS	RATESVILLE	ARK	INDEPENDENCE
050346	PARAGOULD INTERCEPTOR	PARAGOULD	ARK	GREENE
050347	HOPE SS	HOPE	ARK	HEMPSTEAD
050350	GREENBRIER SEWERAGE SYST	GREENBRIER	ARK	FAULKNER
050358	CENTERION COLLECTION SYS	CENTERION	ARK	BENTON
050367	WEST SLIDE W T T WORKS	JOHNSHOP	ARK	CHAFFHEAD
050369	CONWAY INTERCEPTORS	CONWAY	ARK	FAULKNER
050395	HULL SHOALS SS	BULL SHOALS	ARK	MARION
050397	HATFIELD SS	HATFIELD	ARK	PULK
050399	HUNTINGTON SS	HUNTINGTON	ARK	SEBASTIAN
060740	NORTH POINT CROSSTOWN INT	SAN FRANCISCO	CALIF	SAN FRANCISCO
060763	KERMAN INTERCEPTORS	KERMAN	CALIF	FRESNO
060772	FORCE MAIN	SCOTT'S VALLEY	CALIF	SANTA CRUZ
060778	ALTAVILLE INTERCEPTOR	ANGELS	CALIF	CALAVERAS
060786	SOLINAS COLLECTION	MOLINAS	CALIF	MARIN
060810	SUISUN-CORNELIA SYSTEM	FALPHELD	CALIF	SOLANO
060813	INYO CO. SEWERS	INYO	CALIF	INYO
060816	REGIONAL COLLECTION	LAKEPORT	CALIF	LAKE
060823	MT. SHASTA INTERCEPTOR	MT. SHASTA	CALIF	SISKIYOU
060840	NORTH INTERCEPTOR	YUBA CITY	CALIF	SUTTER
060859	MONTCLAIR INTERCEPTOR	MONTCLAIR	CALIF	SAN BERNARDIN
060880	HOLLISTER SS	HOLLISTER	CALIF	SAN BENITO
060887	JURUPA INTERCEPTOR	HIVESIDE	CALIF	HIVESIDE
060906	SAN JOSE CREEK INTERCEPT	WHITTIER	CALIF	LOS ANGELES
060915	NAPA INTERCEPTOR	NAPA	CALIF	NAPA
060938	INTERCEPTOR	SACRAMENTO	CALIF	SACRAMENTO
060940	GRAND TERRACE COLLECTION	COULTON	CALIF	SAN BERNARDIN


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GRANT NO	FACILITY NAME	CITY	STATE	COUNTY
060950	ESTERO INTERCEPT	SAN MATEO	CALIF	SAN MATEO
060956	SHASTA DAM AREA COLLECTIO	CENTRAL VALLEY	CALIF	SHASTA
060957	SANTA ANA INTERCEPT	SANTA ANA	CALIF	ORANGE
060961	NORTH-SOUTH INTERCEPT	STOCKTON	CALIF	SAN JOAQUIN
060967	FAST SONORA INTERCEPT	SUNORA	CALIF	TUOLUMNE
060991	FLYTHE SS	FLYTHE	CALIF	RIVERSIDE
061062	MCKINLEYVILLE COLLECTION	MCKINLEYVILLE	CALIF	HUMBOLT
061086	REDDING SS	REDDING	CALIF	SHASTA
061112	SONOMA CNTY SS	SANTA ROSA	CALIF	SONOMA
061121	TAHOE-TRUCKEE INTERCEPT	TAHOE VISTA	CALIF	NEVADA
061139	LOS CUYOTES INTERCEPT	LOS ANGELES	CALIF	LOS ANGELES
061151	HERNDON INTERCEPT	FRESNO	CALIF	FRESNO
061230	NORTHEAST INTERCEPT	SACRAMENTO	CALIF	SACRAMENTO
061230	NORTHEAST INTERCEPT	SACRAMENTO	CALIF	SACRAMENTO
061230	NORTHEAST INTERCEPT	SACRAMENTO	CALIF	SACRAMENTO
061230	NORTHEAST INTERCEPT	SACRAMENTO	CALIF	SACRAMENTO
061230	NORTHEAST INTERCEPT	SACRAMENTO	CALIF	SACRAMENTO
061230	NORTHEAST INTERCEPT	SACRAMENTO	CALIF	SACRAMENTO
061263	POMTA VISTA SS	SACRAMENTO	CALIF	SACRAMENTO
061275	PETTERMAN CITY SS	MONTAVILLE	CALIF	TULARE
061355	MILTON CREEK SS	PETTERMAN CITY	CALIF	KINGS
		MAMMOTH LAKES	CALIF	MONO
080321	FT. COLLINS INTERCEPT	FT. COLLINS	CULO	LARIMER
080322	UPPER THOMPSON WTP	ESTES PARK	CULO	LARIMER
080334	GLENWOOD INTERCEPT	GLENWOOD SPRING	CULO	GARFIELD
080337	PARADISE HILL INTERCEPT	GRAND JUNCTION	CULO	MESA
080337	PARADISE HILLS INTERCEPT	GRAND JUNCTION	CULO	MESA
080338	LOVELAND INTERCEPT	LOVELAND	CULO	LARIMER
080352	SOUTHEAST INTERCEPT	GREELEY	CULO	WELD
080352	LUNG MOUNT WTP & SEWER SYS	LONG MOUNT	CULO	BOULDER
080359	PLATTE II INTERCEPT	DENVER	CULO	DENVER
080370	PLATTE II INTERCEPT	DENVER	CULO	DENVER
080371	DELGANY INTERCEPT	DENVER	CULO	DENVER
080372	SOUTHSIDE INTERCEPT	DENVER	CULO	DENVER
090155	STONINGTON COLLECTION	STONINGTON	CUNN	NEW LONDON
090191	PLYMOUTH SEWERS	PLYMOUTH	CUNN	LITCHFIELD
090194	BRANFORD SS	BRANFORD	CUNN	NEW HAVEN
090215	FAIRFIELD SS	FAIRFIELD	CUNN	FAIRFIELD
090215	FAIRFIELD SS	FAIRFIELD	CUNN	FAIRFIELD
090219	GREENWICH CS	GREENWICH	CUNN	FAIRFIELD
090234	CHOMWELL SS	CHOMWELL	CUNN	MIDDLESEX
090254	FAST HAVEN SS	EAST HAVEN	CUNN	NEW HAVEN
090261	WT VIEW INTERCEPT	ENFIELD	CUNN	HARTFORD
090285	GLASTONHURRY SS	GLASTONHURRY	CUNN	HARTFORD
090296	GHOTON SS	GHOTON	CUNN	NEW LONDON
090304	DAIRY SS	DAIRY	CUNN	FAIRFIELD
090350	FARMINGTON	FARMINGTON	CUNN	HARTFORD
090356	WESTPORT	WESTPORT	CUNN	FAIRFIELD
100055	DEWEY BEACH COLLECTION	DEWEY BEACH	DEL	SUSSEX
100076	FREDERICA W COLLECTION	FREDERICA	DEL	KENT
100094	SO COASTAL REGIONAL SYSTE	BRITANY BEACH	DEL	SUSSEX
100102	TIDBURY BRANCH COLLECTION	DOVER	DEL	KENT
100103	CANON-WYOMING-ISAAC BRAN	DOVER	DEL	KENT
100150	FRESH CHARLTON INTERCEPT	DOVER	DEL	KENT

GRANT NO	FACILITY NAME	CITY	STATE	COUNTY
120377	MIAMI DADE INTERCEPTORS	MIAMI	FLA	DADE
120428	PENSACOLA WTW	PENSACOLA	FLA	ESCAMBIA
120574	LAUDERDALE LAKES P S	LAUDERDALE	FLA	BROWARD
120453	FORCE MAIN & PUMP STATION	DELRAY BEACH	FLA	PALM BEACH
130315	RICHMOND HILL SEWAGE SY	RICHMOND HILL	GA	BRYANT
130357	ALMA	ALMA	GA	HACON
130383	VIDALIA SEWER SYSTEM	VIDALIA	GA	TOOMBS
130395	DALLAS STP	DALLAS	GA	PAULDING
130399	WINNETT COUNTY SW. SYS.	WINNETT	GA	WINNETT
130403	FAYETTEVILLE SEWER SYSTEM	FAYETTEVILLE	GA	FAYETTE
130425	WILMACOOCHEE RIVER INT	VALDOSTA	GA	LOWNDES
130425	MUD CREEK INTERCEPTOR	VALDOSTA	GA	LOWNDES
130430	NOSE CREEK INTERCEPTOR	MARIETTA	GA	CORR
130456	SOUTHEAST FORCE MAIN	CULLFGE PARK	GA	FULTON
130496	SHELLMAN COL. SYS.	SHELLMAN	GA	HANDOLPH
160144	PARIS SEWAGE	PARIS	IND	BEAR LAKE
160156	WOODRUFF AVE INT.	INDIAN FALLS	IND	BONNEVILLE
160166	ORFINO INTERCEPTOR	ORFINO	IND	CLEARWATER
160176	SEWER SYSTEM	SALAMON	IND	LEMMI
160185	MERIDIAN INTERCEPTOR	MERIDIAN	IND	AUA
160196	SOUTH FORK COEUR D'ALENE	WALLACE	IND	SHUSHONE
160204	KINGSTON-CATALDO IS.	PINEHURST	IND	SHUSHONE
160205	CULDESAC WWT	CULDESAC	IND	NEZ PERCE
160205	IONA-BONNEVILLE IS.	INDIAN FALLS	IND	BONNEVILLE
160206	LINDSAY CREEK INTERCEPTOR	LEWISTON	IND	NEZ PERCE
160209	HAGERMAN INTERCEPTOR	HAGERMAN	IND	GOODING
170508	HUSHNELL SEWERS	HUSHNELL	ILL	MCDONOUGH
170680	SPARTA	SPARTA	ILL	HANDOLPH
170924	SALEM	SALEM	ILL	MARION
170970	OF FALLON	OF FALLON	ILL	ST. CLAIR
170983	HEESE SS	HEESE	ILL	CLINTON
171006	HIGHLAND PK. WEST INT.	HEESE	ILL	MCLEAN
171023	PELLEVILLE INTERCEPTORS	HELLFVILLE	ILL	ST CLAIR
171089	GIBSON CITY INTERCEPTOR	GIBSON CITY	ILL	FOND
171107	ROBINSON SS	ROBINSON	ILL	CRAWFORD
171156	MINONK SS	MINONK	ILL	WOODFORD
171196	DUQUOIN	DUQUOIN	ILL	PERRY
171202	MATTOON	MATTOON	ILL	COLES
171294	WOODRIDGE INTERCEPTORS	WHEATON	ILL	DUPAGE
171294	FAST BRANCH INTERCEPTOR	WOODRIDGE	ILL	DU PAGE
171310	MT. VERNON INTERCEPTORS	MT. VERNON	ILL	JEFFERSON
171335	SYCAMORE SS	SYCAMORE	ILL	DEKALB
171365	ARTHUR	ARTHUR	ILL	DOUGLAS
171397	HINSDALE SO SEWERS	HINSDALE	ILL	DUPAGE
171412	CARPENTERSVILLE INTERCPT	CARPENTERSVILLE	ILL	KANE
171420	WILMONT TOWNSHIP SEWERS	CHICAGO HEIGHTS	ILL	COOK/WILL
171686	NAPERVILLE INTERCEPTOR	NAPERVILLE	ILL	DUPAGE
171714	DEERFIELD INTERCEPTORS	DEERFIELD	ILL	LAKE
171795	FAST SIDE LOW LEVEL INT	HUCKLEBERRY	ILL	WINNEBAGO
171796	ROCKFORD SANITARY DISTRICT	THOCKFORD	ILL	WINNEBAGO
171797	ROCKFORD SANITARY DISTRICT	THOCKFORD	ILL	WINNEBAGO
171799	ROCKFORD SANITARY DISTRICT	THOCKFORD	ILL	WINNEBAGO
175023	POPLAR CREEK INTERCEPTOR	CHICAGO	ILL	COOK
175024	MSD OF CHICAGO	CHICAGO	ILL	COOK
175030	MSD OF CHICAGO	CHICAGO	ILL	COOK

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175054	INTERCEPTION	CHICAGO	ILL	COOK
175102	CALOMET INTERCEPTOR	CHICAGO	ILL	COOK
175130	MSD OF CHICAGO	CHICAGO	ILL	COOK
175150	SALT CREEK INTERCEPTION	CHICAGO	ILL	COOK
175321	MSD OF GREATER CHICAGO	CHICAGO	ILL	COOK
175322	UPPER DES PLAINES INTERCEPT	CHICAGO	ILL	COOK
175353	MSD OF CHICAGO	CHICAGO	ILL	COOK
180240	SWEETSER SEWERS	SWEETSER	IND	GRANT
180260	NORTH WESTER	NORTH WESTER	IND	KOSCIUSKO
180291	INDEPENDENCE HILL CID COLL	LOOMIS POINT	IND	LAKE
180328	SHELBOURN	SHELBOURN	IND	SULLIVAN
180329	LINDEN COLLECTION SYSTEM	LINDEN	IND	MONTGOMERY
180335	FLORA SEWERS	FLORA	IND	DAVIESS
180346	HINDSEY INTERCEPTION	HINDSEY	IND	DUBOIS
180350	HAMLET SS	HAMLET	IND	STARKE
180354	WILLIAMSPORT SEWERS	WILLIAMSPORT	IND	WARREN
180375	POME CITY	POME CITY	IND	NOBLE
180400	BRUOKLYN	BRUOKLYN	IND	MORGAN
180405	HITTING SEWERS	HITTING	IND	LAKE
180425	KNIGHTSVILLE-HARMONY COLL	KNIGHTSVILLE	IND	CLAY
180434	CLARKS HILL COLL SYSTEM	CLARKS HILL	IND	TIPPECANOE
180445	CAMEL INTERCEPTOR	CAMEL	IND	HAMILTON
180467	SEYMOUR FORCE MAIN	SEYMOUR	IND	JACKSON
180470	PARAGON SEWERS	PARAGON	IND	MORGAN
180473	LAUREL	LAUREL	IND	FRANKLIN
180479	SEELYVILLE COLLECTION	SEELYVILLE	IND	VIGO
180484	CLAY CITY	CLAY CITY	IND	CLAY
180494	COVINGTON INTERCEPTOR	COVINGTON	IND	FOUNTAIN
180502	SUNMAN	SUNMAN	IND	KIPLEY
180509	MYMERA SS	MYMERA	IND	SULLIVAN
180520	NEW PROVIDENCE COLL SYS	NEW PROVIDENCE	IND	CLARK
180526	STAUNTON COLL SYS	STAUNTON	IND	CLAY
180528	MARTINSVILLE INTERCEPTORS	MARTINSVILLE	IND	MORGAN
180533	PRINCETON SEWERS	PRINCETON	IND	GIRSON
180542	HUNTINGTON	HUNTINGTON	IND	HUNTINGTON
180547	NORTH AREA INTERCEPTORS	MUNCIE	IND	DELAWARE
180555	PENNSVILLE SEWERS	PENNSVILLE	IND	JAY
180574	HUSWELL	HUSWELL	IND	HENTON
180591	CONVERSE	CONVERSE	IND	MIAMI
180614	FRANKFORT SS	FRANKFORT	IND	CLINTON
180638	HICKBELL SEWERS	HICKBELL	IND	KNOW
180757	BLUFFTON SEWERS	BLUFFTON	IND	WELLS
180866	GREENHORN	GREENHORN	IND	JOHNSON
180874	WICHMOND AREA Regional SD	WICHMOND	IND	WAYNE
180877	INDIANAPOLIS, ETAL.	INDIANAPOLIS	IND	MARION
190568	WEST LIBERTY WEFHM	WEST LIBERTY	IOWA	MUSCATINE
190598	SAC INTERCEPTOR	SAC	IOWA	SAC
190605	MAKLAN INTERCEPTOR	MAKLAN	IOWA	SHELBY
190608	EAGLE GROVE INTERCEPTOR	EAGLE GROVE	IOWA	WRIGHT
190617	WOOLSTOCK SEWERS	WOOLSTOCK	IOWA	WEBSTER
190637	SPEICER INTERCEPTOR	SPEICER	IOWA	CLAY
190668	INDIANOLA INTERCEPTORS	INDIANOLA	IOWA	WARREN
190672	WALFORD SEWERS SYSTEM	WALFORD	IOWA	BENTON
190763	JANESVILLE INTERCEPTOR	JANESVILLE	IOWA	BREMEN
190800	WAVERLY FORCE MAIN	WAVERLY	IOWA	BREMEN

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200415	JUNCTION CITY INTERCEPTION	JUNCTION CITY	KANS	DEAR
200420	ATLANTA COLLECTION SYSTEM	ATLANTA	KANS	CUMLEY
200444	WICHITA STATE INTERCEPTION	WICHITA	KANS	SEDGWICK
200450	SILVER LAKE SEWER	SILVER LAKE	KANS	SHAWNEE
200524	MINNEAPOLIS INTERCEPTION	MINNEAPOLIS	KANS	DICKINSON
200527	FREEDOMIA HOUSE STATION	FREEDOMIA	KANS	WILSON
200534	INDEPENDENCE SEWER SYSTEM	INDEPENDENCE	KANS	MONTGOMERY
200542	TONGANOXIE INTERCEPTION	TONGANOXIE	KANS	LEAVENWORTH
200550	HUTLER COUNTY S. D. #12	HUTLER	KANS	HUTLER
200565	LA HABRA SEWER	LA HABRA	KANS	HUTLER
200573	PHILLIPSBURG INTERCEPTION	PHILLIPSBURG	KANS	ALLAN
200576	PARSONS INTERCEPTION	PARSONS	KANS	PHILLIPS
200630	DEAR INTERCEPTION	DEAR	KANS	LABETTE
200631	WARKLAND INTERCEPTION	WARKLAND	KANS	SEDGWICK
200648	PLUE MAPLE SEWER STATION	PLUE MAPLE	KANS	SEDGWICK
200653	WORTH INTERCEPTION	WORTH	KANS	MARSHALL
200684	NORTH DEWITT SEWER SYSTEM	NORTH DEWITT	KANS	HARVEY
200690	WILCOX INTERCEPTION	WILCOX	KANS	HARVEY
200693	PITTSBURG INTERCEPTION	PITTSBURG	KANS	RILEY
200770			KANS	CHAMFORD
220292	JEANETTE SEWERAGE SYST	JEANETTE	LA	JEANETTE
220295	HASLET SEWERAGE SYST	HASLET	LA	EVANGELINE
220307	GILBERT SEWERAGE SYST	GILBERT	LA	FANKLIN
220309	VIVIAN SEWERAGE SYST	VIVIAN	LA	CADDO
220310	PLEASANT HILL SEWERAGE	PLEASANT HILL	LA	SABINE
220314	ROSEBINE SEWERAGE SYST	ROSEBINE	LA	VERNON
220321	LIVINGSTON SEWERAGE SYST	LIVINGSTON	LA	LIVINGSTON
220340	WEST WUCHITA COLL SYSTEM	WEST WUCHITA	LA	WUCHITA
220340	WEST WUCHITA SS	WEST WUCHITA	LA	WUCHITA
220340	YOUNGSVILLE SS	YOUNGSVILLE	LA	LAFAYETTE
220561	WENYVILLE SS	WENYVILLE	LA	HEAUREGARD
230102	FORT FAIRFIELD INTERCEPTION	FORT FAIRFIELD	MAINE	ANDUSTOOK
230114	OLD ORCHARD BEACH TAIL	OLD ORCHARD BEACH	MAINE	YORK
230117	SOUTH PORTLAND INTERCEPT	SOUTH PORTLAND	MAINE	CUMBERLAND
230122	PORTLAND AND INTERCEPT	PORTLAND	MAINE	CUMBERLAND
230146	DIARFIELD SS	DIARFIELD	MAINE	OXFORD
240172	CALVERT CO SANITARY DIST	CALVERT	MD	CALVERT
240180	FRIENDSVILLE SEWERS	FRIENDSVILLE	MD	GARRETT
240224	FREEDOM DIST	FREEDOM	MD	CARROLL
240243	ACCIDENT TOWN OF	ACCIDENT	MD	GARRETT
240255	WILLARD'S SEWERS	WILLARD'S	MD	WICOMICO
240284	WMAF AREA INTERCEPT	CENTREVILLE	MD	QUEEN ANNE'S
240294	HARMAN INTERCEPTION	ANAPOLIS	MD	ANNE ARUNDEL
240298	LAVALLE SEWERS	LAVALLE	MD	ALLEGANY
240299	HALLFORD CREEK WTW	FREDERICK	MD	FREDERICK
240311	FREEDOM DISTRICT INTERCEPT	SYRACUSE	MD	CARROLL
240312	INTERCEPT	BALTIMORE	MD	BALTIMORE
240318	CLEAR SPRING SEWERS	CLEAR SPRING	MD	WASHINGTON
240319	WILLIAMSPORT INTERCEPTION	WILLIAMSPORT	MD	WASHINGTON
240326	DEEP RUN INTERCEPTION	ELLICOTT	MD	HOWARD
240339	BROADWATER INTERCEPTION	ANAPOLIS	MD	ANNE ARUNDEL
240339	BROADWATER CELLU PHASE II	BROADWATER	MD	ANNE ARUNDEL
240342	SAUER-SCHMIDT MANURE CS	TOWNS	MD	BALTIMORE



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240343	HELMAN PUMP STATION	TOWSON	MD	BALTIMORE
240348	MARGATE COLLECTION SYSTEM	MARGATE	MD	ANNE ARUNDEL
240352	SPRING BRANCH INTERCEPT	TOWSON	MD	BALTIMORE
240357	DEAD RUN INTERCEPT	BALTIMORE	MD	BALTIMORE CT
240363	DORSEY RUN INTERCEPT	ELLICOTT	MD	HOWARD
240368	BENFIELD RD. INTERCEPT	ANNAPOLIS	MD	ANNE ARUNDEL
240374	ACCORKE AREA INTERCEPT	ACCORKE	MD	PRINCE GEORGE
240393	SMITH ISLAND COLLECTION	SMITH ISLAND	MD	SUMMERSET
240399	FREEDOM INTERCEPT	WESMINSTER	MD	CARROLL
240422	FREDRICK CHTY WETHO STP	FREDRICK	MD	FREDRICK
240445	FOUNTAINHEAD SS	MAGESTOWN	MD	WASHINGTON
240453	RUSH CREEK FORCE MAIN	LONG HAW HARBOR	MD	HARFORD
240464	ALLEGANY CNTY SS	CUMMERSLAND	MD	ALLEGANY
240506	INDIA CREEK SEWERS	MYATTSVILLE	MD	PRINCE GEORGE
240539	FROGTOWN INTERCEPT	HELAIM	MD	HARFORD
240553	THURMONT CS	THURMONT	MD	FREDRICK
240561	COOPERS HARBOR INTERCEPT	TOWSON	MD	BALTIMORE
240605	SEVERN PARK INTERCEPT	ANNAPOLIS	MD	ANNE ARUNDEL
240624	MT. WILSON INTERCEPT	TOWSON	MD	BALTIMORE
250266	HADFORD INTERCEPT	HADFORD HILL	MA	ESSEX
250270	ORANGE INTERCEPT	ORANGE	MA	FRANKLIN
250279	PALMER SS	TOWNSHIRE	MA	HAMPDEN
250298	SOUTH HADLEY SEWERS	SOUTH HADLEY	MA	HAMPDEN
250300	HULL WWTW & SEWERS	HULL	MA	PLYMOUTH
250311	NATTAPOLSETT SEWERS	NATTAPOLSETT	MA	PLYMOUTH
250315	FAIRHAVEN SEWERS	FAIRHAVEN	MA	BRISTOL
250318	HARDWICK WWTW	HARDWICK	MA	WORCESTER
250320	LENOX SS	LENOX	MA	BERKSHIRE
250324	LANCASTER SD	LANCASTER	MA	WORCESTER
250330	LEE SS	LEE	MA	WORCESTER
250333	AMHERST SS	AMHERST	MA	BERKSHIRE
250346	WESTFIELD SEWERS	WESTFIELD	MA	HAMPDEN
250372	EAST LONGMEADOW SS	EAST LONGMEADOW	MA	HAMPDEN
250374	AGAWAM SS	AGAWAM	MA	HAMPDEN
250399	SALEM SS	SALEM	MA	ESSEX
250428	PLAINVILLE SS	PLAINVILLE	MA	ESSEX
250503	MELROSE SEWERS	MELROSE	MA	NORFOLK
262034	HARROW SPRINGS AREA SEWER	HARROW SPRINGS	MICH	MIDDLESEX
262053	CHATHAM INTERCEPT	CHATHAM	MICH	EMMET
262088	MOUNT CLEMENS	MOUNT CLEMENS	MICH	ALGER
262110	CADILLAC	CADILLAC	MICH	MACOMB
262148	GRATIOT CO.-FULTON DPM	ITHACA	MICH	WEAVER
262314	CHEBOYGAN AREA 4th MAIN	CHEBOYGAN	MICH	GRATIOT
262345	PAY CITY WETTER SEWERS	PAY CITY	MICH	CHEBOYGAN
262397	MUNROE CO. DRAIN CATCH	MUNROE	MICH	DAY
262449	LENAWEE CO. DRAIN COMM.	ADRIAN	MICH	MUNROE
262462	PORT HURON	PORT HURON	MICH	LENAWEE
262462	PT. HURON TWP.	PORT HURON	MICH	ST. CLAIR
262491	MT CLEMENS & CLINTON AREA	MT CLEMENS	MICH	ST. CLAIR
262501	OMOSSO	OMOSSO	MICH	MACOMB
262503	HIG RAPIDS INTERCEPT	HIG RAPIDS	MICH	STIAWASEE
262504	NILES TOWNSHIP SEWERS	ST JOSEPH	MICH	MECOSTA
262516	CALEDONIA SS	CALEDONIA	MICH	HEMLOCK
262527	OMOSSO-CALEDONIA SEWERS	OMOSSO	MICH	KENT
262535	PASOON	PASOON	MICH	STIAWASEE
262541	TOUJA SEWERS	MASON	MICH	INGHAM
		TOUJA	MICH	TOUJA

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262543	LUCE CO. BIPW	NEW HERRY	MICH	LUCE
262597	GRATIOT CO. - ALMA, ARCADE, ..	ITHACA	MICH	GRATIOT
262613	MUNROE CO.	MUNROE	MICH	MUNROE
262614	MUNROE CO. FRENCH TOWN BEACH	MUNROE	MICH	MUNROE
262639	ALLEGAN	ALLEGAN	MICH	ALLEGAN
262646	ST. CLAIR CO.	PORT HURON	MICH	ST. CLAIR
263212	PAVILION TWP	SCOTT	MICH	KALAMAZOO
263241	FAST HAY TOWNSHIP SEWERS	THAVRESE CITY	MICH	GRAND TRAVERS
263271	JONESVILLE SEWERS	JONESVILLE	MICH	HILLSDALE
263279	MARQUETTE CNTY	ISHPEMING	MICH	MARQUETTE
270043	DOVER-EYOTA SEWERS	ST. CHARLES	MINN	WINONA
270720	VIRGINIA	VIRGINIA	MINN	ST. LOUIS
270720	VIRGINIA	VIRGINIA	MINN	ST. LOUIS
270747	ST. CLOUD	ST. CLOUD	MINN	STEARNS
270748	WESTERN LAKE SUPERIOR, ETC	DULUTH	MINN	ST. LOUIS
270818	STOCKTON COLLECTION SYS	STOCKTON	MINN	WINONA
270821	MOUNTAIN THON SS	MOUNTAIN THON	MINN	ST. LOUIS
270824	ST. PETER & KASOTA, ETAL.	ST. PETER	MINN	LE SUEUR
270837	TAUNTON COLL SYSTEM	TAUNTON	MINN	LYON
270838	ZIMMERMAN INTERCEPTOR	ZIMMERMAN	MINN	SHERBORN
270844	ALEXANDRIA LAKE AREA SS	ALEXANDRIA	MINN	DOUGLAS
270845	RHEEZY POINT FORCE MAIN	RHEEZY POINT	MINN	CHOW WING
270845	RHEEZY POINT SS	RHEEZY POINT	MINN	CHOW WING
270854	ELK RIVER SS	ELK RIVER	MINN	SHERRURNE
270949	MARSHALL LAKE	MARSHALL	MINN	LYON
270970	MADISON LAKE	MADISON LAKE	MINN	BLUE EARTH
279012	OKONO LONG LAKE SS	ST PAUL	MINN	RAMSEY
280316	PICHLAND W & S DISTRICT	JACKSON	MISS	RANKIN
280370	WEST HANKIN FORCE MAIN	JACKSON	MISS	HINDS
280380	JACKSON INTERCEPTORS	JACKSON	MISS	HINDS
280380	TOWN CREEK SEWER	JACKSON	MISS	HINDS
280540	MANTACHIE SEWER SYSTEM	MANTACHIE	MISS	ITAWAMBA
290524	MONETT SEWER SYSTEM	MONETT	MO	HARRY
290560	WENTZVILLE SEWERS	WENTZVILLE	MO	ST. CHARLES
290603	NEVADA WTP & INTERCEPTOR	NEVADA	MO	VERNON
290628	HERRY HILLS INTERCEPTOR	ST. LOUIS	MO	BRIDGETON
290637	WISSON CREEK INTERCEPTOR	SPRINGFIELD	MO	GREENE
290646	WYATT SEWER SYSTEM	WYATT	MO	MISSISSIPPI
290650	FLAT RIVER INTERCEPTOR	FLAT RIVER	MO	ST. FRANCIS
290655	WARRENSBURG SEWERS	WARRENSBURG	MO	JOHNSON
290658	CUBA SEWER SYSTEM	CUBA	MO	CALLOWAY
290662	HEUTER COLLECTION SYSTEM	HEUTER	MO	MACON
290669	QUIN PUMP STATION	QUIN	MO	BUTLER
290674	WARRENTON SEWERS	WARRENTON	MO	WARREN
290683	TIPTON SEWER SYSTEM	TIPTON	MO	MONITEAU
290689	ST. ROBERT INTERCEPTOR	ST. ROBERT	MO	PULASKI
290696	CARUTHERSVILLE COLL. SYS.	CARUTHERSVILLE	MO	PEMISCOTT
290701	ST. JAMES SEWERS	ST. JAMES	MO	PHELPS
290711	HOUBRON SEWER SYSTEM	HOUBRON	MO	CRAWFORD
290747	HUFFALO SEWER SYSTEM	HUFFALO	MO	DALLAS
290751	WAYNESVILLE SEWERS	WAYNESVILLE	MO	PULASKI
290794	HOUSTON SEWER SYSTEM	HOUSTON	MO	TEXAS
290834	CEDAR CITY INTERCEPTOR	CFDA / CITY	MO	CALLOWAY
290874	BEAR-PERCHE INTERCEPTOR	COLUMBIA	MO	BOONE
290943	MAYBRUK INTERCEPTOR	LEE'S SUMMIT	MO	JACKSON

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29079	SUGAR CREEK INTERCEPTOR	INDEPENDENCE	MO	JACKSON
300194	FLAXVILLE SEWERS	FLAXVILLE	MONT	DANIELS
300199	MISSOULA STP & INT	MISSOULA	MONT	MISSOULA
310393	WAKEFIELD FORCE MAIN	WAKEFIELD	NEBR	DIXON
310407	BLAIR SEWER SYSTEM	BLAIR	NEBR	WASHINGTON
310421	SPRINGFIELD WTP & SEWERS	SPRINGFIELD	NEBR	SAMPY
310433	YORK SEWER SYSTEM	YORK	NEBR	YORK
310435	ARLINGTON SEWER SYSTEM	ARLINGTON	NEBR	WASHINGTON
310453	GRAND ISLAND INTERCEPTORS	GRAND ISLAND	NEBR	HALL
310476	VALLEY SEWER SYSTEM	VALLEY	NEBR	DOUGLAS
310493	DEAD MAN'S RUN IS.	LINCOLN	NEBR	LANCASTER
310550	BLUF HILL FORCE MAIN	BLUE HILL	NEBR	WEBSTER
310562	NORFOLK INTERCEPTOR	NORFOLK	NEBR	MADISON
310575	THEFORD FORCE MAIN	THEFORD	NEBR	THOMAS
320076	YERINGTON SEWERS	YERINGTON	NEV	LYON
320083	MELLIS INTERCEPTOR PH. I	LAS VEGAS	NEV	CLARK
320084	EAST LAS VEGAS LIFT STA	EAST LAS VEGAS	NEV	CLARK
320088	INCLINE COLLECTION	INCLINE VILLAGE	NEV	WASHOE
320091	REATTY SEWERS	REATTY	NEV	NYE
320094	FERNLEY INTERCEPTOR	FERNLEY	NEV	LYON
320097	MCDERMITT SEWERS	MCDERMITT	NEV	HUMBOLDT
320105	MELLIS INTERCEPTOR	LAS VEGAS	NEV	CLARK
320107	OVERTON STP	OVERTON	NEV	CLARK
320108	SEARCHLIGHT SEWERS	SEARCHLIGHT	NEV	CLARK
320113	WASHOE CNTY SS	INCLINE VILLAGE	NEV	WASHOE
320126	GARDNERVILLE RANCHOS SS	GARDNERVILLE	NEV	DOUGLAS
330093	MANCHESTER INTERCEPTOR	MANCHESTER	NH	HILLSBOROUGH
330104	ALLENSTOWN SEWERS	ALLENSTOWN	NH	MERRIMACK
330111	HEMLIN SS	HEMLIN	NH	COOS
330119	WARNER VILL. F.A.D. SEWERS	WARNER	NH	MERRIMACK
330137	LISBON SEWER SYSTEM	LISBON	NH	GRAFTON
330138	UPPER HOLDENNESS VILLAGE	PLYMOUTH	NH	GRAFTON
330190	DOVER SS	DOVER	NH	STAFFORD
330215	MERRIMACK SS	MERRIMACK	NH	HILLSBOROUGH
330225	LEBANON	LEBANON	NH	GRAFTON
340333	PARTISPPANY-TROY HILLS INT	PARTISPPANY	NJ	MORRIS
340334	EDISON TOWNSHIP INT SEWER	EDISON	NJ	MIDDLESEX
340344	ATLANTIC COUNTY S.A.	ATLANTIC CITY	NJ	ATLANTIC
340345	SECAUCUS SEWER SYSTEM	SECAUCUS	NJ	HUDSON
340354	PEQUANNOCK LINCOLN PARK	FAIRFIELD	NJ	ESSEX
340356	OCEAN CO. SEWERAGE AUTH(N)	TOMS RIVER	NJ	OCEAN
340358	PEMHEUTON M.W.A.	NEW LISBON	NJ	BURLINGTON
340365	SURREY DRIVE SEWERS	WAYNE	NJ	PASSAIC
340372	OCEAN COUNTY	TOMS RIVER	NJ	OCEAN
340377	S. MONMOUTH M.S.A.	SPRING LAKE	NJ	MUNMOUTH
340441	HOPEWELL SANITARY SEWERS	HOPEWELL	NJ	MERCER
340444	PENNINGTON SEWERS	PENNINGTON	NJ	MERCER
340455	FIELDSHIRE SEWERS	FIELDSHIRE	NJ	BURLINGTON
340471	MOUNTAIN LAKES	MOUNTAIN LAKES	NJ	MORRIS
340478	HOCKAWAY TWP. SEWERS	HOCKAWAY	NJ	MORRIS
340479	POINT PLEASANT	POINT PLEASANT	NJ	OCEAN
340484	HAMSFY SEWER SYSTEM	HAMSFY	NJ	BERGEN
340491	WEST WINDSON TWP. SS	PRINCETON JCT.	NJ	MERCER

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340492	LACEY SEWER SYSTEM	FORKED RIVER	NJ	OCEAN
340496	ETHELLE SEWER SYSTEM	BRITTON	NJ	MUNMOUTH
340499	LONG BEACH COLLECTION SYS	HEACH HAVEN	NJ	OCEAN
340507	MANULOKING SEWERS	MANULOKING	NJ	MORRIS
340534	MANULOKING TWP M.U.A.	MANULOKING	NJ	MORRIS
340563	OCEAN TWP. SEWERS	WAKEFORD	NJ	OCEAN
340592	MARAH SEWER SYSTEM	WAKEFORD	NJ	HERGEN
340597	BRIDGEWATER TWP. SEWERS	BRIDGEWATER	NJ	SOMERSET
340610	LANDIS SEWER SYSTEM	VINELAND	NJ	CUMBERLAND
340621	WALL TWP. SEWER SYSTEM	WALL	NJ	MUNMOUTH
340657	WAYNE TWP. PUMP STATIONS	WAYNE	NJ	PASSAIC
350171	LAS CRUCES	LAS CRUCES	NM	DONA ANA
350184	LORDSHURST SEWERS	LORDSHURST	NM	HILDAALGO
351015	PATON COLL SYS	KATOI	NM	COLFAX
351019	ALBUQUERQUE SS	ALBUQUERQUE	NM	BERNALILLO
351029	PORTALES SEWAGE SYSTEM	PORTALES	NM	HOUSSEVELT
351034	LAS VEGAS STP	LAS VEGAS	NM	SAN MIGUEL
360384	MARION SEWER SYSTEM	MARION	NY	WAYNE
360389	PENNSSELAR COUNTY S.D.	TRUY	NY	WENESLAER
360391	TONAWANDA	TONAWANDA	NY	ERIE
360413	WAYLAND SEWER SYSTEM	WAYLAND	NY	STEBEN
360433	SAG HARBOR SEWAGE SYS.	SAG HARBOR	NY	SUFFOLK
360445	ONTARIO TOWN SEWAGE SYS	ONTARIO	NY	WAYNE
360495	N TONAWANDA MFW	N TONAWANDA	NY	NIAGARA
360525	WATERLIFT	WATERLIFT	NY	ALBANY
360534	SACKETS HARBOR STP	SACKETS HARBOR	NY	JEFFERSON
360545	CROSTOWN INTERCEPTOR	WHESTER	NY	MUNROE
360611	ELLICOTTVILLE INT	ELLICOTTVILLE	NY	CATTARAUGUS
360618	AMHERST STP SYS	WILLIAMSVILLE	NY	ERIE
360631	WILLIAMSON INTERCEPTOR	WILLIAMSON	NY	WAYNE
360634	GUILDFORD-NORMANS KILL	GUILDFORD	NY	ALBANY
360640	WALTON SEWERS	WALTON	NY	DELAWARE
360644	WATERFORD SEWAGE SYSTEM	WATERFORD	NY	SARATOGA
360646	COBLESKILL	COBLESKILL	NY	SCHENECTADY
360652	ADAMS COLLECTION SYSTEM	ADAMS	NY	JEFFERSON
360667	CHESTER SEWER SYSTEM	CHESTER	NY	ORANGE
360680	CHAUTAUQUA LAKE SD	MAYVILLE	NY	CHAUTAUQUA
360691	ORANGE CO. S.D. #1	GOSHEN	NY	ORANGE
360707	NIAGARA CO S.D. #3	NIAGARA	NY	NIAGARA
360711	GRAND ISLAND INTERCEPTOR	GRAND ISLAND	NY	ERIE
360720	SCOTTA SEWER TAP	SCOTTA	NY	SCHENECTADY
360725	CLINTON SS	CLINTON	NY	ONEIDA
360732	MINETTO SEWER SYSTEM	MINETTO	NY	OSWEGO
360747	NIAGARA FALLS AWT	NIAGARA FALLS	NY	NIAGARA
360764	PORT FREN SEWER SYSTEM	PORT FREN	NY	ULSTER
360771	WESTFIELD SEWER IMPROVEM	WESTFIELD	NY	CHAUTAUQUA
360812	SODUS POINT STP	SODUS POINT	NY	WAYNE
360824	ALBION AWT	ALBION	NY	ORLEANS
360826	VESTAL SEWER SYSTEM	VESTAL	NY	BROOME
360854	DEPOSIT SEWER SYSTEM	UPPERSIT	NY	BROOME
360859	MARATHON SEWER SYSTEM	MARATHON	NY	CORTLAND
360914	SHERMAN SEWER SYSTEM	SHERMAN	NY	CHAUTAUQUA
360922	SOMERSET-HARKEN INTERCEPT	HARKEN	NY	NIAGARA
360927	VARICK SEWER SYSTEM	HOMOLUS	NY	SENACA
360943	STARCH FACTORY INTERCEPT	UTICA	NY	ONEIDA
360945	LIMESTONE INTERCEPTOR	MANLIVS	NY	ONONDAGA

GRANT NO	FACILITY NAME	CITY	STATE	COUNTY
360968	LAKE GEORGE PUMP STATION	LAKE GEORGE	NY	WARREN
361065	PEMINGTON SEWER SYSTEM	PEMINGTON	NY	MUNROE
361085	YONKATON SEWER SYSTEM	YONKATON	NY	WESTCHESTER
370364	TARBORO STW	TARBORO	NC	EDGECOMBE
370377	MALLARD CREEK INTERCEPTION	CHARLOTTE	NC	MECKLENBURG
370377	TUBBY CREEK INTERCEPTION	CHARLOTTE	NC	MECKLENBURG
370383	FARMVILLE STW	FARMVILLE	NC	EDGECOMBE
370417	DUNN INTERCEPTIONS	DUNN	NC	HARNETT
370433	RED SPRINGS INTERCEPTION	RED SPRINGS	NC	HOMESON
370434	SPRING LAKE	SPRING LAKE	NC	CUMBERLAND
370441	MOORE COUNTY REGIONAL STW	CAROLINA	NC	MOORE
380277	MAY CREEK INTERCEPTION	ELIZABETH	ND	BURLEIGH
380294	FREDERLIN STW & SS	FREDERLIN	ND	RANSOM
380313	SHELDON LAKE AND CS	SHELDON	ND	RANSOM
380324	HARVEY FORCE MAIN	HARVEY	ND	WELLS
380325	WANDAN INTERCEPTION	WANDAN	ND	MORTON
380332	CHERRY SEWERS	CHERRY	ND	HARVEY
380332	WAS. INTERCEPTION PHASE III	FARGO	ND	CASS
380375	VERONA INTERCEPTION	VERONA	ND	LAMOTHE
380379	SOUTH FORT WARD	SOUTH	ND	BOTTINEAU
380394	WOODMONT COLLECTION	WOODMONT	ND	STUTSMAN
380465	REULAH INTERCEPTION	REULAH	ND	MERCER
390491	WOOD COUNTY SS # 400	WHEELERS GREEN	OHIO	WOOD
390562	PORTAGE CO. HAVENNA S.D.	HAVENNA	OHIO	PORTAGE
390579	HAMILTON COUNTY INTERCEPT	CINCINNATI	OHIO	HAMILTON
390580	MINERAL CITY	MINERAL CITY	OHIO	TUSCARAWAS
390624	GEARDA CO. S.W. CLEVELAND CRR	CLEVELAND	OHIO	GEARDA
390626	LIMA INTERCEPTIONS	LIMA	OHIO	ALLEN
390630	HUNTON SEWAGE SYSTEM	HUNTON	OHIO	GEARDA
390640	FAYE-WOODS INTERCEPTION	ARROW	OHIO	SUMMIT
390644	CINCINNATI INTERCEPTIONS	CINCINNATI	OHIO	PICKAWAY
390645	OHIO INTERCEPTIONS	OHIO	OHIO	LUCAS
390657	MEDINA COUNTY INTERCEPTION	MEDINA	OHIO	MEDINA
390659	EASTWEST AREA INTERCEPT	CLEVELAND	OHIO	CUYAHOGA
390663	MASKINS COLL SYSTEM	MASKINS	OHIO	WOOD
390660	NEW KNOXVILLE COLL SYSTEM	NEW KNOXVILLE	OHIO	AUGLAIZE
390663	FRENCH CREEK SEWERS	MORTA KNOXVILLE	OHIO	LORAIN
390664	HEATHER WATERSEAL STAL	YOUNGSTOWN	OHIO	MAHONING
390702	MONTGOMERY CO INTERCEPTION	DAYTON	OHIO	MONTGOMERY
390717	PROSPECT	PROSPECT	OHIO	MARION
390718	YOUNGSTOWN	YOUNGSTOWN	OHIO	MAHONING
390728	THENTON SEWAGE SYSTEM	THENTON	OHIO	MAHONING
390733	LOPAIN SEWERS	LOPAIN	OHIO	RUTLER
390735	CLARK COUNTY SS	LOHAR	OHIO	LOHAR
390740	F. SCOTO HAVANCA SEWER	SPRINGFIELD	OHIO	CLARK
390744	FLOOMINGBUSH	COLUMBUS	OHIO	FRANKLIN
390754	SHEPARD COLL SYSTEM	REDDINGHAM	OHIO	PAYETTE
390765	WOODSTOCK ESTATES INTERCEPT	SHEPARD	OHIO	DEFIANCE
390844	MALVERN SS	COLUMBUS	OHIO	FRANKLIN
390875	MIAMI CONS DIST SEWERS	MALVERN	OHIO	CARROLL
390895	DUBLIN SEWERS	SPRINGFIELD	OHIO	WARREN
390999	WESTERVILLE SEWERS	DUBLIN	OHIO	FRANKLIN
390902	WASAW SS	WESTERVILLE	OHIO	FRANKLIN
390915	WEST TWIN CREEK INTERCEPT	WASAW	OHIO	COSHOC
		WHEELERS	OHIO	MIAMI

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GRANT NO	FACILITY NAME	CITY	STATE	COUNTY
390926	ORCHARD HILL INTERCEPTION	MIAMI SHURG	OHIO	MONTGOMERY
390940	STARK COUNTY SEWERS	CANTON	OHIO	STARK
390982	SOUTH POINT COLL SYSTEM	SOUTH POINT	OHIO	LAWRENCE
390990	CEDAR POINT SANITARY	SANDUSKY	OHIO	EMIE
391001	PREBLE COUNTY COLL SYSTEM	FATON	OHIO	PREBLE
391005	ASHLEY	COLUMBUS	OHIO	DELAWARE
391008	GENIA	XENIA	OHIO	WHEENE
391104	LUCAS CITY-WOOD RD INT	MAUMEE	OHIO	LUCAS
391257	HHAULEY ROAD SEWER	CLEVELAND	OHIO	CUYHOGA
391259	PERRYVILLE SS	PERRYVILLE	OHIO	ASHLAND
400413	JANFAA COLLECTION SYSTEM	SAPULPA	OKLA	CREEK
400537	SEWORA SEWERS	SEWORA	OKLA	SEMINOLE
400563	SEWCO INTERCEPTOR	TULSA	OKLA	TULSA
400577	KETCHUM SEWAGE SYSTEM	KETCHUM	OKLA	CHAIG
400638	AMREP COLLECTION SYSTEM	AMREP	OKLA	GRADY
400640	KINGSTON SS	KINGSTON	OKLA	MARSHALL
400644	COTTON CO WOOD COLL SYSTEM	MANDLETT	OKLA	CUTTON
400648	ALTUS INTERCEPTOR	ALTUS	OKLA	JACKSON
400654	ARKOMA SS	ARKOMA	OKLA	LE FLORE
400658	MUSTANG SS	MUSTANG	OKLA	CANADIAN
400674	STILLWATER INTERCEPTORS	STILLWATER	OKLA	PAYNE
400682	PERRY SEWERS	STILLWATER	OKLA	PAYNE
400743	MARTHA SEWERS	PERRY	OKLA	NOBLE
400763	OKMULGEE SS	MARTHA	OKLA	JACKSON
400874	NO. CANADIAN INTERCEPTOR	OKMULGEE	OKLA	OKMULGEE
400877	WITCHER PUMP STATION	OKLAHOMA CITY	OKLA	OKLAHOMA
400945	PONCA CITY	PONCA CITY	OKLA	OKLAHOMA
410323	METARTS INTERCEPTORS	OKLAHOMA CITY	OKLA	KAY
410342	SOUTHEAST RELIEF IS.	OKLAHOMA CITY	OKLA	KAY
410365	PEPOE BAY STP	OKLAHOMA CITY	OKLA	KAY
410390	INTERCEPTOR SYSTEM	OKLAHOMA CITY	OKLA	KAY
410411	REDWOOD SANITARY DISTRICT	OKLAHOMA CITY	OKLA	KAY
410416	CLOVERDALE STP	OKLAHOMA CITY	OKLA	KAY
410417	PACIFIC CITY INTERCEPTOR	OKLAHOMA CITY	OKLA	KAY
410424	ROADMAN INTERCEPTOR	OKLAHOMA CITY	OKLA	KAY
410432	SWEET HOME INTERCEPTOR	OKLAHOMA CITY	OKLA	KAY
410434	GLENDALE SEWER SYSTEM	OKLAHOMA CITY	OKLA	KAY
410436	SOUTHPLIN INTERCEPTOR	OKLAHOMA CITY	OKLA	KAY
410438	JOHN DAY INTERCEPTOR	OKLAHOMA CITY	OKLA	KAY
410444	MULALLA SEWER SYSTEM	OKLAHOMA CITY	OKLA	KAY
410450	LINCOLN CITY INTERCEPTOR	OKLAHOMA CITY	OKLA	KAY
410455	HEAVENTON-HOCK CREEK INT.	OKLAHOMA CITY	OKLA	KAY
410501	CHEFSENT VALLEY RELIEF	OKLAHOMA CITY	OKLA	KAY
410524	COVE SEWER SYSTEM	OKLAHOMA CITY	OKLA	KAY
410555	GLEW CREEK TRUNK SEWER	OKLAHOMA CITY	OKLA	KAY
410600	CANYON CITY INTERCEPTOR	OKLAHOMA CITY	OKLA	KAY
420600	VALLEY FORGE SEWER AUTH.	OKLAHOMA CITY	OKLA	KAY
420621	MALVERN MUNICIPAL AUTH	OKLAHOMA CITY	OKLA	KAY
420622	PONTAGE JOINT SEWER AUTH	OKLAHOMA CITY	OKLA	KAY
420657	TRI-RURO MUNICIPAL AUTH	OKLAHOMA CITY	OKLA	KAY
420701	MOSHANNON VALLEY J.S.A.	OKLAHOMA CITY	OKLA	KAY
420707	MC CANDLES TWP SAN. AUTH	OKLAHOMA CITY	OKLA	KAY
420711	HAMILTON TWP AUTH	OKLAHOMA CITY	OKLA	KAY
420712	OLEY TWP MUNICIPAL AUTH.	OKLAHOMA CITY	OKLA	KAY

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420719	ALEXANDRIA CS	ALEXANDRIA	PA	HUNTINGDON
420723	ADAMS TOWNSHIP	DUALO	PA	CAMBRIA
420724	STONYCREEK (UPPER) J.M.A.	HOOVERSVILLE	PA	SOMERSET
420733	THOMPSON TOWN MUNCIPAL AUTH.	THOMPSON TOWN	PA	JUNIATA
420739	POINT MARION MUNCIPAL AUTH.	POINT MARION	PA	FAYETTE
420742	TREMONT MUNICIPAL AUTH.	TREMONT	PA	SCHUYLKILL
420744	MILLCREEK TWP SEWER AUTH.	EMIE	PA	EMIE
420760	SYKESVILLE MUNICIPAL AUTH.	SYKESVILLE	PA	JEFFERSON
420761	ADAMS TOWNSHIP	DUALO	PA	CAMBRIA
420769	FRANKLIN	FRANKLIN	PA	VE VANGO
420774	WINDSOR TWP MUNCIPAL AUTH.	RED LION	PA	YORK
420775	CARMICHAELS-CUMBERLAND JT	CARMICHAELS	PA	GREENE
420781	SCHUYLKILL HAVEN MUNCIPAL AUTH.	SCHUYLKILL HAVEN	PA	SCHUYLKILL
420783	BROWN TWP MUNICIPAL AUTH.	NEEDSVILLE	PA	MIFFLIN
420793	FREEDOM COL. SYS.	FAST FREEDOM	PA	HLAIR
420799	MONONGAHELA MUNICIPAL AUTH.	MONONGAHELA	PA	WASHINGTON
420800	SO. PARK TWP SEWER AUTH.	LIRAHAY	PA	WASHINGTON
420810	SHIPPENSBURG COL. SYS.	SHIPPENSBURG	PA	ALLEGHENY
420820	MOUNTAIN TOP AREA	MOUNTAIN TOP	PA	CUMBERLAND
420837	PENN TWP SEWERAGE AUTH.	HARRISON CITY	PA	LUZERNE
420841	GROVE CITY SS	GROVE CITY	PA	WESTMORELAND
420849	JACKSON TWP. COL. SYS.	MYERSTOWN	PA	MERCER
420853	MILLCREEK-RICHLAND C. S.	NEWMANSTOWN	PA	LEBANON
420883	NESHANNOK TWP	NEW CASTLE	PA	LEBANON
420900	WRIGHT TWP. COL. SYS.	BEAVER	PA	LAWRENCE
420902	DELEWARE COUNTY PUMP STA	WIDLEY PARK	PA	BEAVER
420906	UNION SEWER & DISPOSAL AU	NEW CASTLE	PA	DELEWARE
420909	MIDDLETON TWP SS	LIMA	PA	LAWRENCE
420916	HAMILTON TWP. COL. SYS.	CHAMBERSBURG	PA	DELAWARE
420917	PORTER-TOWER JOINT M.A.	TOWER CITY	PA	FRANKLIN
420931	LOWER GWYNEDD TWP. SS.	SPRING HOUSE	PA	SCHUYLKILL
420938	ALLEGHENY TOWNSHIP SEWERS	NEW KENSINGTON	PA	MONTGOMERY
420939	RETHLEHEM TOWNSHIP SS	BETHLEHEM	PA	WESTMORELAND
420953	FINDLAY SS	IMPERIAL	PA	NORTHAMPTON
420992	FAIRVIEW TWP AUTH.	NEW CUMBERLAND	PA	ALLEGHENY
420993	PENN HILLS	PENN HILLS	PA	YORK
420996	BRIDGEWATER ROROUGH SEWER	BRIDGEWATER	PA	ALLEGHENY
420997	WEST GOSHEN S. S.	WEST CHESTER	PA	BEAVER
421002	LYNN TWP SS	LYNNPORT	PA	CHESTER
421004	HARRISBURG SEWERAGE AUTH.	HARRISBURG	PA	LEHIGH
421023	MARSHALL TWP. COL. SYS.	MARSHDALE	PA	DAUPHIN
421033	PENNSHORE SS	SELLENSVILLE	PA	ALLEGHENY
421048	UNITY TWP SS	LATHROP	PA	BUCKS
421071	BUTLER AREA SEWERS	BUTLER	PA	WESTMORELAND
421107	LOWER MERTON TWP. SS.	ARMORE	PA	BUTLER
421144	FRANKLIN COL. SYS.	WAYNESBURG	PA	MONTGOMERY
421147	PADNOR INTERCEPTOR	WAYNE	PA	GREENE
440074	KLUCK ISLAND SEWER SYSTEM	NEW SHOREHAM	RI	DELEWARE
440086	SMITHFIELD COLLECTION	SMITHFIELD	RI	WASHINGTON
440087	JAMESTOWN SS	JAMESTOWN	RI	PROVIDENCE
440089	NO SMITHFIELD SS	NO SMITHFIELD	RI	NEWPORT
440089	NO SMITHFIELD SS	NO SMITHFIELD	RI	PROVIDENCE
440089	NO SMITHFIELD SS	NO SMITHFIELD	RI	PROVIDENCE
440089	NO SMITHFIELD SS	NO SMITHFIELD	RI	PROVIDENCE
440089	NO SMITHFIELD PUMP ST	NO SMITHFIELD	RI	PROVIDENCE
440089	MIDDLETON SS	MIDDLETON	RI	NEWPORT
450265	SANTEE PUBLIC SERVICE DIS	SANTEE	SC	ORANGEBURG

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GRANT NO	FACILITY NAME	CITY	STATE	COUNTY
450204	GREENVILLE COUNTY S.A.	GREENVILLE	SC	GREENVILLE
450321	AIKEN CO MO OF COMMISSION	AIKEN	SC	AIKEN
450321	AIKEN COUNTY INTERCEPT	AIKEN	SC	AIKEN
450466	OCONEE COUNTY INTERCEPT	OCONEE	SC	OCONEE
450379	ANDERSON CO & S. CO. 44	ANDERSON	SC	ANDERSON
460222	VIVIAN LAGOON & COLL. SYS	VIVIAN	SO	LYMAN
460231	LEAN-DEARLON INTERCEPT	LEAN-DEARLON	SO	LAWRENCE
460234	KITCHELL FORCE MAIN	KITCHELL	SO	DAVISON
460238	LAMONA SEWER SYSTEM	LAMONA	SO	LAKE
460240	WAPIN VALLEY COLLECTION	WAPIN CITY	SO	PERKINSON
460243	GARRE COLLECTION SYSTEM	FORT PIERCE	SO	STANLEY
460259	HENRY COLLECTION SYSTEM	HENRY	SO	COCKINGTON
460264	PRATHE MEADOWS COLL. SYS	STONIA FALLS	SO	MINNEAPOLIS
460272	BRIDGINGS INTERCEPT	BRIDGINGS	SO	BRIDGINGS
460276	FLAMM COLLECTION SYSTEM	FLAMM	SO	FLAMM
460293	FLAMM SEWER SYSTEM	FLAMM	SO	FLAMM
460472	GRUET LAGOON & COLL. SYS.	GRUET	SO	GRUET
470355	MACFARLAN COLLECTION SYSTEM	MACFARLAN	TENN	HUMPHREYS
470457	CENTREVILLE SEWERS	CENTREVILLE	TENN	WICKMAN
470463	MCLOUTH COUNTY SEWERS	MCLOUTH	TENN	MCLOUTH
480856	CHUCKETT CITY INTERCEPT	CHUCKETT	TEXAS	HOUSTON
480878	WERTON SEWAGE SYSTEM	WERTON	TEXAS	WERTON
480899	SAN JUAN SEWERS	SAN JUAN	TEXAS	MOJES
480931	PALESTINE SEWAGE SYSTEM	PALESTINE	TEXAS	ANDERSON
480934	KEMERVILLE SEWAGE SYSTEM	KEMERVILLE	TEXAS	KERR
480952	GULFPORT SPRINGS SEWAGE	GULFPORT SPRINGS	TEXAS	HOPKINS
480981	CROSBY COLLECTION SYSTEM	CROSBY	TEXAS	HARRIS
481088	HEVIL OAKS SS	HEVIL OAKS	TEXAS	JEFFERSON
481110	QUENA VISTA INTERCEPT	QUENA VISTA	TEXAS	VAL VERDE
481112	WILLIS SS	WILLIS	TEXAS	WILLIS
481123	TEXAS CITY SS	TEXAS CITY	TEXAS	MONTGOMERY
481168	GILMER COLLECTION SYSTEM	GILMER	TEXAS	GALVESTON
481169	ALVORD INTERCEPT	ALVORD	TEXAS	UPSHUR
481191	LUMBERTON MOU SS	LUMBERTON	TEXAS	WISE
481203	COPPELL SS	COPPELL	TEXAS	HARDIN
481271	SOMERSET SS	SOMERSET	TEXAS	DALLAS
490142	CELANO CITY WWTP	CELANO CITY	UTAH	BEAR
490151	WUTON HOLLOW INTERCEPT	WUTON HOLLOW	UTAH	LEON
490152	BYRON CITY WTP & SEWERS	BYRON CITY	UTAH	DAVIS
490171	WELLSVILLE INTERCEPT	WELLSVILLE	UTAH	CACHE
490175	TROPTON TOWN OF	TROPTON	UTAH	CACHE
490180	WATON COLLECTION SYSTEM	WATON	UTAH	GARFIELD
490181	EMERY TOWN POND & COLL.	EMERY TOWN	UTAH	DUCHESNE
490182	SEWER LINE EXTENSION	SEWER LINE	UTAH	EMERY
490191	LEHI INTERCEPT	LEHI	UTAH	CARSON
490197	SYDNEYVILLE INTERCEPT	SYDNEYVILLE	UTAH	UTAH
490207	TIAMOGOS INTERCEPT	TIAMOGOS	UTAH	SUMMIT
490212	ALPINE INTERCEPT	ALPINE	UTAH	UTAH
490244	CASTLE VALLEY INTERCEPT	CASTLE VALLEY	UTAH	EMERY
500079	KRAMER INTERCEPT	KRAMER	VT	MUTLAND
500081	MARLBOROUGH INTERCEPT	MARLBOROUGH	VT	WINDSOR
500083	NORTH BARNHART I.O. SEWERS	NORTH BARNHART	VT	WINDHAM
500089	WINDSOR FALLS COLLECTION	WINDSOR FALLS	VT	FRANKLIN

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500000	SOUTH HOUSTON SS	HOUSTON	TX	HOUSTON
500105	PACIFIC STEEL SS	SEATTLE	WA	CLATSOP
500115	PEABODY SS	PEABODY	VT	FRANKLIN
500117	ROYALTON SS	ROYALTON	VT	FRANKLIN
510250	FIELDALE REGIONAL COLL.	FIELDALE	VA	PRINCE WILLIAM
510331	UPPER OCCOCHAN SAN. DIST.	UPPER OCCOCHAN	VA	PRINCE WILLIAM
510343	VIRGINIA BEACH SEWERS	VIRGINIA BEACH	VA	PRINCE WILLIAM
510355	CLIFTON FORGE COLL.	CLIFTON FORGE	VA	ALLEGANY
510375	STANTON SEWERS	STANTON	VA	ALLEGANY
510383	MOORE HILL	MOORE HILL	VA	ALLEGANY
510384	WAVELLY SEWERS	WAVELLY	VA	ALLEGANY
510446	PIVANIA WATER & SEWER AUT.	PIVANIA	VA	ALLEGANY
510446	PIVANIA WATER & SEWER AUT.	PIVANIA	VA	ALLEGANY
510447	PLATON-MASSACHUSETTS REGIONAL	PLATON	MA	ALLEGANY
510490	PLACER SEWERS	PLACER	CA	ALLEGANY
510494	PLACER SEWERS-VPI SAN. AUT.	PLACER	CA	ALLEGANY
510500	DEENVILLE SAN. SEWERS	DEENVILLE	VA	ALLEGANY
510500	PIVANIA INTERCEPTOR	PIVANIA	VA	ALLEGANY
510515	POUND COLLECTION SYSTEM	POUND	VA	ALLEGANY
510515	JAMES CITY CO. SAN. DIST.	JAMES CITY	VA	ALLEGANY
530446	ALICE HAY (WATER) COLL.	ALICE HAY	TX	ALLEGANY
530470	SEWARD PARK INTERCEPTOR	SEWARD PARK	TX	ALLEGANY
530484	WESTPORT SAN. DIST.	WESTPORT	TX	ALLEGANY
530521	WHEELER SAN. DIST.	WHEELER	TX	ALLEGANY
530534	TAUSICK SAN. DIST.	TAUSICK	TX	ALLEGANY
530540	STEVENS PASS-VPI SAN. DIST.	STEVENS PASS	TX	ALLEGANY
530553	WHITE SAN. DIST.	WHITE	TX	ALLEGANY
530555	NEWARK INTERCEPTOR	NEWARK	TX	ALLEGANY
530560	LOUISIANA INTERCEPTOR	LOUISIANA	TX	ALLEGANY
530564	GRANCO INTERCEPTOR	GRANCO	TX	ALLEGANY
530569	LAUREL LEACH SAN. DIST.	LAUREL LEACH	TX	ALLEGANY
530574	VALLEY SEWER SYSTEM	VALLEY	TX	ALLEGANY
530581	FOX AVE INTERCEPTOR	FOX AVE	TX	ALLEGANY
530582	WASHOUGAH INTERCEPTOR	WASHOUGAH	TX	ALLEGANY
530604	SHELTON FENCE MAIN	SHELTON FENCE	TX	ALLEGANY
530714	CLARK COUNTY SEWERS	CLARK COUNTY	TX	ALLEGANY
530720	MURKIN INTERCEPTOR	MURKIN	TX	ALLEGANY
530724	HYDRO-2000 COLLECTION	HYDRO-2000	TX	ALLEGANY
530740	GLENN COUNTY INTERCEPTOR	GLENN COUNTY	TX	ALLEGANY
530746	SAN. NEWTON ST. INTERCEPT	SAN. NEWTON ST.	TX	ALLEGANY
530806	VAL VUE INTERCEPTOR	VAL VUE	TX	ALLEGANY
530811	FOUR SEWER INTERCEPTOR	FOUR SEWER	TX	ALLEGANY
530812	WISMAN INTERCEPTOR	WISMAN	TX	ALLEGANY
530826	UNION SAN. DIST.	UNION	TX	ALLEGANY
530837	WHEELER SAN. DIST.	WHEELER	TX	ALLEGANY
540204	DELMAR SAN. DIST.	DELMAR	TX	ALLEGANY
540213	ELIZABETH SAN. DIST.	ELIZABETH	TX	ALLEGANY
540241	ELIZABETH SAN. DIST.	ELIZABETH	TX	ALLEGANY
540244	WITCO COLLECTION SYSTEM	WITCO	TX	ALLEGANY
540335	STONEMOUNT COLLECTION	STONEMOUNT	TX	ALLEGANY
540336	WALTON COL. SYS.	WALTON	TX	ALLEGANY
540349	COAL HILL COL.	COAL HILL	TX	ALLEGANY
540427	PIVANIA SAN. DIST.	PIVANIA	TX	ALLEGANY
550514	LOUISIANA SAN. DIST.	LOUISIANA	TX	ALLEGANY

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550569	MT HOMEH INTERCEPTOR	MT HOMEH	WIS	DANE
550573	LUMIRA INTERCEPTOR	LUMIRA	WIS	DODGE
550625	MONTREAL INTERCEPTOR	MONTREAL	WIS	IRON
550631	OCOUNOMOC INTERCEPTOR	OCOUNOMOC	WIS	WAUKESHA
550649	OMRO SS	OMRO	WIS	WINNEBAGO
550670	INTERCEPTOR SEWER	MILWAUKEE	WIS	MILWAUKEE
550787	MARSHFIELD SEWERS	MARSHFIELD	WIS	WOOD
550790	STOUGHTON INTERCEPTOR	STOUGHTON	WIS	DANE
550820	NORTHERN MARSHFIELD SEWER	ELKHART LAKE	WIS	SHERIDAN
550921	HEART OF THE VALLEY SEWER	NAUKAUNA	WIS	OUTAGAMIE
550952	FOND DU LAC SS	FOND DU LAC	WIS	FOND DU LAC
560103	THERMOPOLIS INTERCEPTOR	THERMOPOLIS	WYO	HOT SPRINGS
560104	COWLEY STP & COLLECTION	COWLEY	WYO	BIG HORN
560110	LABARGE WWT & COLL. SYS.	LABARGE	WYO	LINCOLN